Integrate, Consolidate and Disseminate
European Flood Risk Management Research

Research supported by the 2nd ERA-NET CRUE Funding Initiative for Research in Flood Risk Management







Flood resilient communities – managing the consequences of flooding

ANNEX A TO THE FIM FRAME FINAL REPORT

CRUE Research Report No 1: Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
The Effectiveness and Robustness of Emergency Plans for Floods

Prepared by the Joint Project Consortium consisting of

Project partner #1, HR Wallingford, UK

Project partner #2, Deltares, The Netherlands

Project partner #3, Laboratoire Central Des Pont Et Chaussées, France

Project partner #4, University Montpellier III, France

CRUE Co-ordinator: John Goudie (Defra)
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DISCLAIMER

Flood Incident Management – A FRAMEwork for improvement

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
The Effectiveness and Robustness of Emergency Plans for Floods

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Flood resilient communities – managing the consequences of flooding

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
The Effectiveness and Robustness of Emergency Plans for Floods

CRUE Research Report No I-1

Prepared by

Project partner #1, HR Wallingford, UK

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CRUE Funding Initiative on FRM

John Goudie
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Summary

This report has been produced as part of Work Package 1 (WP1) of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME). The following activities were carried out within the framework of WP1:

- A comparison of flood emergency planning practices in England and Wales, France and the Netherlands;
- Development of metrics to assess the completeness and the level of detail of a flood emergency plan;
- Review of flood emergency plans in England and Wales, France and the Netherlands to gain an insight into their current status, to identify where the emphases within the plans lie and to enable a comparison between the countries;
- An internet survey of stakeholders responsible or involved in producing emergency plans for floods to assess their requirements for flood emergency plans;

From the research it was concluded that there is often a lack of homogeneity between the emergency plans that have been reviewed. Although to a certain extent this is to be expected given the different nature of the flood risk in the areas covered by the plans that were reviewed. However, the same information for example was often expressed in significantly different levels of detail. Many of the plans reviewed had what could be classed as a large amount of generic “cut and paste” text on flooding but had limited text on local or regionally specific issues. It would appear from the research that many stakeholders would like more specific information especially with regards to the nature of the flood hazard and the accessibility of roads to emergency services and other vehicles for different flooding scenarios.

The metrics developed as part of the research proved to be a useful tool for assessing emergency plans, for identifying strong points and weaknesses, as well as providing a basis for comparison of the plans. The following conclusions can be reached regarding emergency plans in the Netherlands:

- Metrics such as “plan activation”; “actions, roles and responsibilities”, “flood warning” and “target audience and updating”; and “aims and objectives” were well covered in most of the plans reviewed
- In all three countries there appeared to be a lack of information in plans on critical infrastructure
- There was great emphasis given by the stakeholders on having more information the accessibility of roads during flood events
- The Netherlands had the best score relating to risk to people in emergency plans. In France and England and Wales there was “room for improvement” in the treatment of risk to people, particularly vulnerable groups
- There is a difference in the way that flood hazard is depicted in emergency plans between England and Wales, France and the Netherlands.

Contents

1 Introduction

1.1 Background to the research

This report has been produced as part of Work Package 1 (WP1) of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME).

FIM FRAME is a 24 month project research project. The project is funded by:

- The joint Department for Environment, Food and Rural Affairs (Defra)/Environment Agency Flood And Coastal Erosion Risk Management (FCERM) Research and Development Programme and
- The Ministère de l'Ecologie, de l'Energie, du Développement Durable et de la Mer, en charge des Technologies Vertes et des Négociations sur le Climat (MEEDDM).

The research is being undertaken in the UK, France and the Netherlands. The project partners are:

- HR Wallingford, UK – Project coordinator;
- Deltares, The Netherlands;
- Gestion des Sociétés, des Territoires et des Risques (GESTER), University of Montpellier III, France;
- Laboratoire Central des Ponts et Chaussées (LCPC), Nantes, France.

The objectives of the research can be summarised as follows:

- To assess the “effectiveness” of a sample of current flood emergency plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved;
- To evaluate the current tools and technical systems that are used to inform flood emergency plans and the ability of these tools to support future flood event emergency planning with the main aim of reducing residual risk (i.e. primarily loss of life);
- To establish how currently available tools (e.g. guidelines, models) can be used to improve emergency management plans for floods and whether there are any gaps in the tools that are available;
- To provide a framework by which flood incident management can be improved that will be tested in a number of case studies.

The research has been carried out in six Work Packages (WPs) as follows:

- WP1 - Effectiveness and robustness of flood event management plans;
- WP2 - Comparison of currently available tools for the emergency planning of floods;
- WP3 - Development of framework to improve flood event management;
- WP4 - Case studies utilising the developed framework to improve emergency plans working together with emergency responders, emergency planners and other stakeholders;
- WP5 - Dissemination of the results;
- WP6 - Management and coordination.

The relationship between the six Work Packages is shown in Figure 1.1.

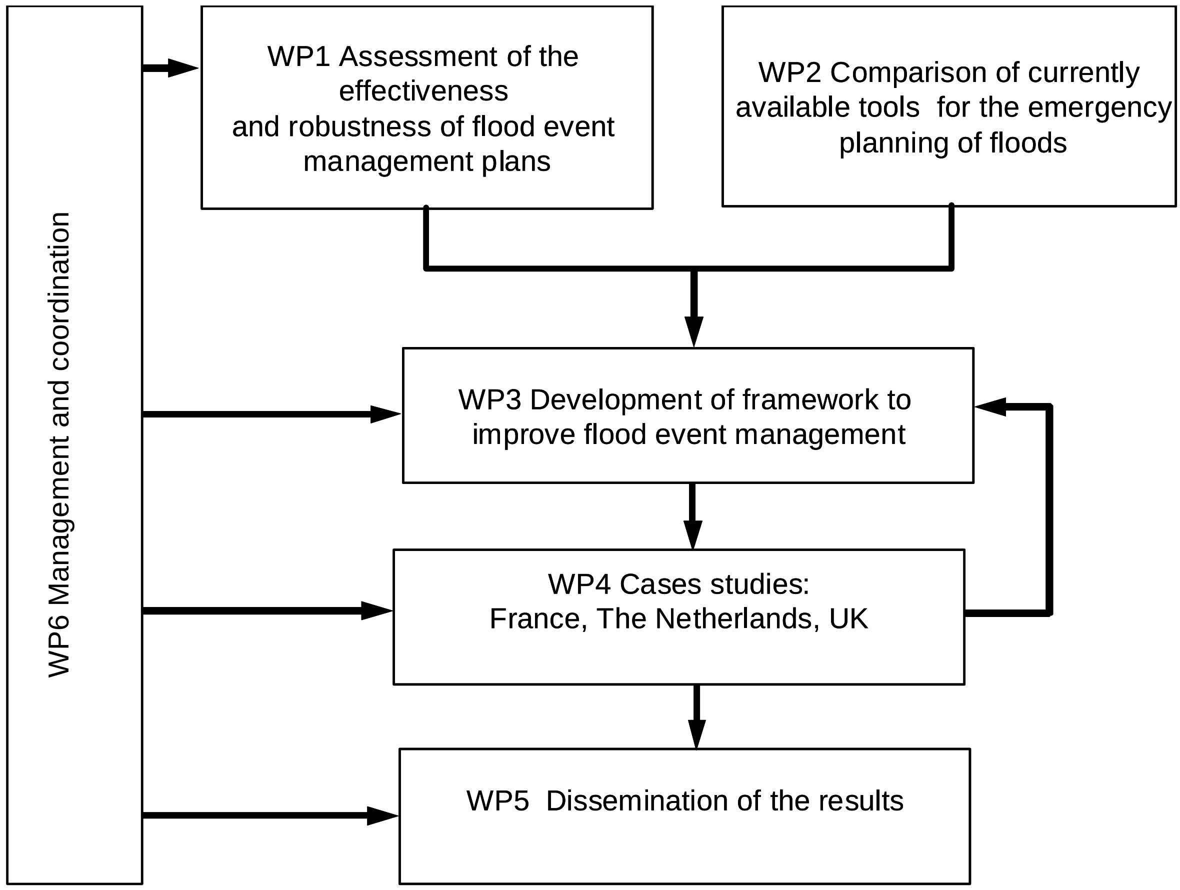


Figure 1.1 Relationship between the FIM FRAME Work Packages

1.2 Background to Work Package 1 (WP1) of FIM FRAME

The overall effectiveness of an emergency response to a flood is a difficult entity to measure. Every flood is different and every response is different. There is no standardised method for obtaining data and information on the response to an actual flood. Furthermore, relying on data sets of disasters collected from various agencies leads to ambiguous terms, inconsistent and incomplete data.

There are currently significant weaknesses in emergency plans for floods. For example, in the UK in 2006 it was found that:

- 30% of emergency plans have not been published or communicated to people in the area;
- 30% of emergency plans have not been seen or validated by the Environment Agency;
- Police plans do not have flood evacuation routes identified and 20% do not include traffic management measures in their evacuation plans at all.

In the Netherlands, the Taskforce Management for Floods (TMO) was initiated in 2006. The objective of the TMO was to improve the flood preparedness in the Netherlands. The TMO was concluded in 2008 with a national exercise simulating the 'worst conceivable flood'. From the TMO programme it was also concluded that flood emergency planning needed improvement.

The key question that needs to be addressed is if and how it can be established if emergency plans for floods are fit for purpose. A first step is to evaluate the so-called robustness or completeness of a plan. However, a plan that is "complete" could still be "ineffective" owing to the accessibility of the plan or level of detail of the different components.

The aim of WP1 of the FIM FRAME project is to assess the "effectiveness" of flood emergency plans developed in England and Wales[1], France and the Netherlands. The following research questions were addressed:

- What are the current flood emergency planning practices in England and Wales, France and the Netherlands? What differences and similarities can be identified?
- Can flood emergency plans be evaluated and if so, how can this be done?
- Which elements within the current emergency plans should be addressed and to what level of detail?
- What makes an emergency plan effective?

The following activities were carried out within the framework of WP1:

- Details of and a comparison of flood emergency planning practices in England and Wales, France and the Netherlands;
- Development of metrics to assess the completeness and the level of detail of a flood emergency plan;
- Review of flood emergency plans in England and Wales, France and the Netherlands to gain an insight into their current status, to identify where the emphases within the plans lie and to enable a comparison between the countries. In addition the review acted as a way to assess the usefulness of the metrics for assessing flood emergency plans.
- An internet survey of stakeholders responsible or involved in producing emergency plans for floods to assess their requirements for flood emergency plans, as well as their views on criteria for a plan to be effective;
- Interviews with stakeholders in England and Wales and the Netherlands.

1.3 Structure of the report

The structure of this report is as follows:

- Chapter 1 provides a background to the objectives of the research and this report;
- Chapter 2 gives brief details of the background for emergency planning for floods in England and Wales, France and the Netherlands;
- Chapter 3 outlines of the metrics that were developed to evaluate flood emergency plans in the three countries covered by the research;
- Chapter 4 reviews emergency plans in the three countries carried out using the metrics that have been developed;
- Chapter 5 gives survey results and stakeholder engagement with respect to required elements and information within a plan;
- Chapter 6 provides survey results and stakeholder engagement with respect to criteria on effectiveness of a plan;
- Chapter 7 gives the conclusions of the report;

[1] The remit of the Environment Agency remit only covers England and Wales, so this research does not cover Scotland or Northern Ireland.

- Chapter 8 provides references used to compile the report;
- Appendices provide full details of the stakeholder engagement and full reviews of the emergency management plans that were undertaken.

2 Background to emergency planning for floods in England and Wales, France and the Netherlands

2.1 Introduction

An emergency plan may be defined as a "*coordinated set of protocols for managing an adverse event, whether expected or untoward in the future*" (Alexander, 2005). This chapter provides a brief description of the emergency planning for floods in England and Wales, France and the Netherlands.

2.2 Background to emergency planning for floods in England and Wales

2.2.1 Introduction

Emergency planning in the UK is governed by the Civil Contingencies Act 2004. The Act divides emergency responders into two categories, known as Category 1 and Category 2 Responders depending on the extent of their involvement in civil protection work, and places a proportionate set of duties on each category.

Category 1 responders are those organisations at the core of emergency response (e.g. emergency services, local authorities). Category 1 responders are subject to the full set of civil protection duties. Category 2 organisations (e.g. Health and Safety Executive, transport and utility companies) are "co-operating bodies" that while less likely to be involved in the heart of planning work, will be heavily involved in incidents that affect their sector.

There is a hierarchy of emergency planning in the UK. This is shown in Figure 2.1. Issues such as evacuation, communication and the setting up of rest areas/shelters are generally covered by generic plans. These plans are then referenced by Multi-Agency Flood Plans (MAFP) which include specific information on flooding. The way in which MAFPs fit in with the rest of emergency plans is shown in Figure 2.2.

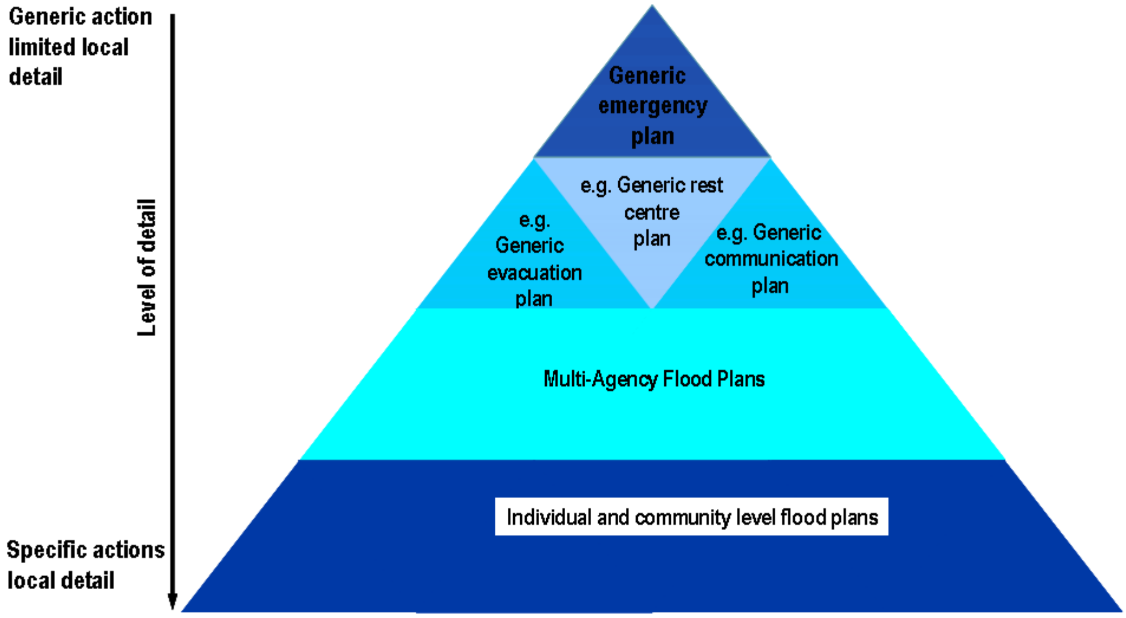
2.2.2 Background to Multi-Agency Flood Plans

In England and Wales, Multi Agency Flood Plans (MAFPs) are produced by the Local Resilience Forum. There are some 43 Local Resilience Forums covering England and Wales that are based on Police areas. Each Local Resilience Forum should consider the flood risk across the whole area for which it is responsible. However, for some areas the response arrangements that are set out in generic emergency places will be sufficient to cover the particular area at risk. For areas where the risk is higher more detailed Multi Agency Flood Plans are required. A specific flood plan is required if:

- The risk falls into the "high" or "very high" category;

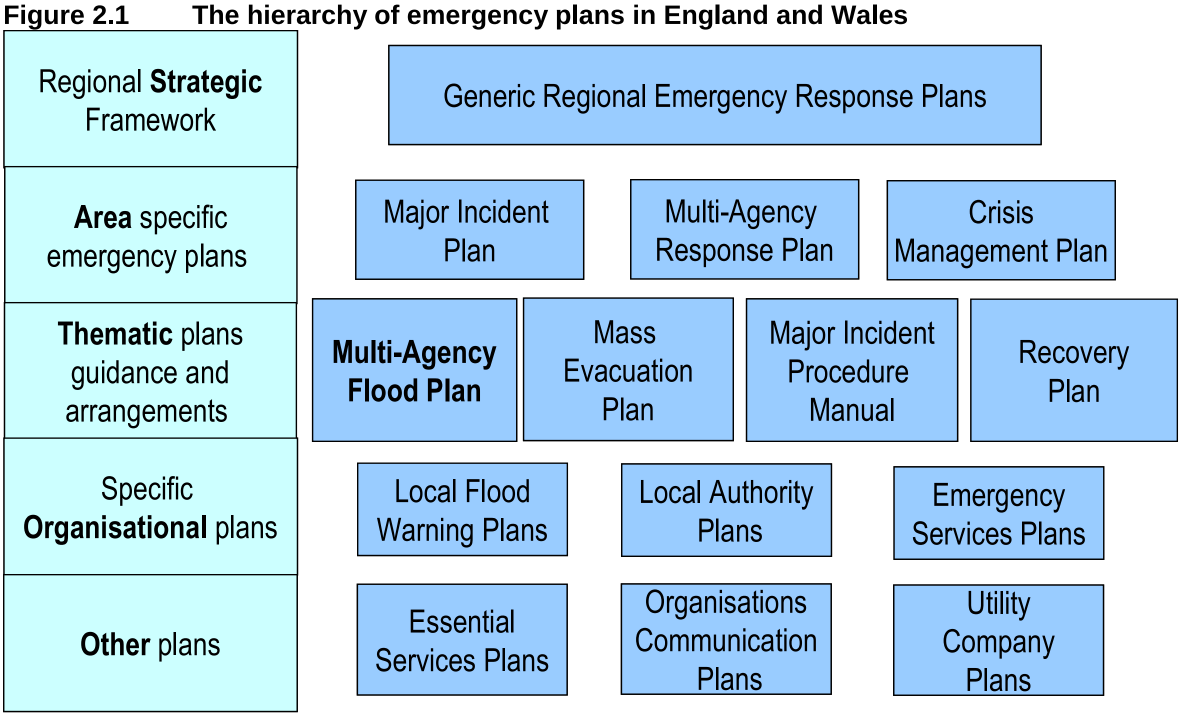
- The number of residential and business properties that are at “significant” or “moderate risk” is classified as substantial or the number of people is excessive;
- The number of vulnerable assets or key infrastructure sites that are at a “significant” or “moderate” level of risk is such that the consequences of flooding would lead to “significant disruptive challenges” that would take days or weeks to put right.

It is also important to note that for reservoirs of a certain size it is also important to produce “off-site” emergency plans, to cover the possibility of dam failures.



(Source: Environment Agency/Defra, 2008)

Figure 2.1 The hierarchy of emergency plans in England and Wales



(Source: Environment Agency/Defra, 2008)

Figure 2.2 How emergency plans “fit together” in England and Wales

2.2.3 *Types of floods planned for in England and Wales at a Multi Agency Flood Plan level ntroduction*

At a Multi-Agency Flood Plan level the types of floods that are generally planned for, where applicable, include: river, sea, tidal, reservoirs, groundwater, surface water and if appropriate failure/overtopping of flood defences. Multi-Agency Flood Plans (MAFP) are not expected to include planning for the flood hazard that could result from foul sewer networks, burst water main, private lakes and canals, unless there is a specific and significant flood risk. In terms of the flood mapping that is shown in the MAFP the guidance states that this is normally limited to maps that show the flood outline for sea and river flooding, where appropriate.

2.3 Background to emergency planning for floods in France

2.3.1 *Introduction*

France is made up of 100 Départements. These are administrative divisions, roughly analogous to the districts of England. The départemental seat of government is called the Préfecture or chef-lieu de département and is generally a city of some importance roughly at the geographical centre of the Départément. The 100 French Départements are grouped into 22 metropolitan and four overseas regions, all of which have identical legal status as integral parts of France. The Départements are further divided into communes, governed by municipal councils. There are approximately 36,700 Communes in France. The Commune is the lowest level of administrative division in France. There is no exact equivalent in the UK. The Communes have a status somewhere in between that of English Districts and Civil Parishes.

It is important to note that the mayor of the Commune plays a central role in France and that he is legally accountable for the security of the citizens and the organisation of rescue operations on the territory of his commune. When an incident extends over more than one commune or its consequences are too important to be managed by local rescue means, the first Départémental State officer (Préfet) takes charge of the emergency operations and a Départemental operational centre is activated. The hierarchy of emergency management in France is shown in Figure 2.3.

Type of event			Command structure	
Example	Characteristics	Actors	Direction of operations	Role of the COD*
• Car accident • Small fire	• Local and immediate consequences • Short duration	Rescue services (standard action)	 Mayor	Watch
• Large car accident • Extended fire	• Local and immediate consequences • Duration of a few hours	Emergency services (rescue with consolidated means)	 Mayor	Follow-up
• Car accident with numerous victims • Accident in the transport of dangerous matters • Problematic fires (industrial sites with a PPI**, tunnels…)	• Local and immediate consequences • Duration of a few hours	Emergency services + Other actors	 Prefet	Support
• Industrial accident • Pollution • Large inundation • Storm	• Extended to several Communes • Duration of a few days • Post-event consequences	Emergency services + Other actors	 Prefet	Direction
• Extended storm (1999) • Epidemic • Extreme flood • Nuclear accident	• Extended to a large part of a département or to several départements • Duration of a few days to few weeks • Post-event consequences	General mobilization	 Prefet	Strengthened direction

Note: * COD: Departmental operational centre with representatives of the various departmental State administrations (rescue services, police, technical services…).
** PPI: Plan Particulier d'Intervention (Specific Emergency Plan)
(Source: Ministère de l'Intérieur, Guide ORSEC départemental, méthode générale, 2006)

Figure 2.3 The hierarchy of emergency management in France

Until recently, emergency plans were only established by the state authorities in France. However, since 2004[2] there has been a move to develop emergency plans at the level of the Communes. It should be noted that in France there are no bespoke emergency plans for floods, other than for reservoir failures.

Emergency planning at national level in France has organised since 1952 around the Organisation de la Réponse de la SEcurité Civile (ORSEC) plan (the organisation of the response and civil security). The ORSEC plan is the main tool for state authorities to manage major and large scale emergencies. The ORSEC plan was updated by a French Act of parliament on 13 August 2004.

[2] 2004-811 law signed the 13 August 2004 on the modernisation of civil security

2.3.2 Regional and Départemental emergency plans

There are three types of ORSEC plans:

- Zonal level ORSEC plans;
- Départemental level ORSEC plans;
- Maritime ORSEC plans.

There are nine Zones in France that include a number of Départements. The purpose of the Zone level ORSEC plans is to coordinate emergencies triggered by high magnitude events that either cover more than one Département or which cannot be managed properly with the rescue means available at the level of one Département. The Département level plans cover the whole Département. There are 94 Départements on mainland France.

The Zones and Départements that cover France are shown in Figure 2.4. The Département level ORSEC plans comprise:

- An inventory and an analysis of the risks and the potential effects of natural and other hazards on people, businesses and the environment;
- Operational plans to respond to an emergency;
- Methods for the preparation and training of emergency responders in both the public and private sector;
- Management of various networks including gas, water, electricity and transport;
- Evacuation of the population.

Falling under the ORSEC plans there are what are known as Plan Particulier d'Intervention (PPI). These are specific plans related to specific assets (e.g. a nuclear station or dam) that could pose a risk to the surrounding population. These are discussed below.

It is important to note that there are also ORSEC plans for maritime regions. These cover specifically: pollution incidents; nuclear accidents at sea; aircraft accidents at sea; and shipwrecks. At a national level there is the Centre Opérationnel de Gestion Interministérielle des Crises (COGIC) which is a national operation centre for the management of emergencies. This gathers information at a national level and manages national emergencies.

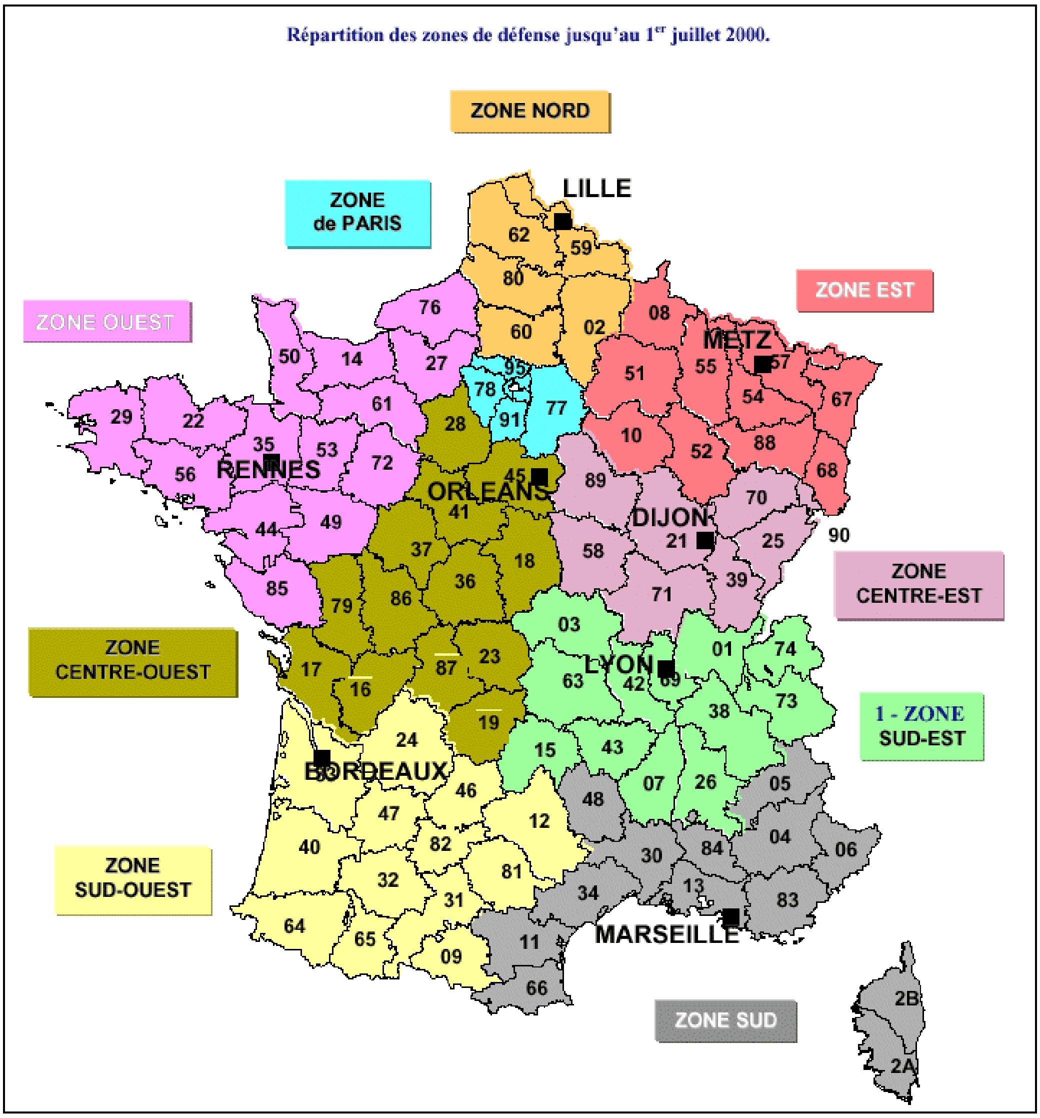


Figure 2.4 **Map of the Zones and Départements in France for which ORSEC plans are produced**

2.3.3 *Plans Communaux de Sauvegarde (PCS) - Municipal emergency plans*

At a communal level in France there is the Plan Communal de Sauvegarde (PCS) (local emergency management plans). The PCSs were created to help municipalities take charge of the management of emergency planning at a local level. It is important to note that there are some 36,700 communes in France. Not all communes have to produce PCSs. PCSs are compulsory for communes where an approved Risk Prevention Plan exists or located in the area of a Plan Particulier d'Intervention, discussed below. It has been a major challenge at local level to get these implemented and to date there has been little feedback as to how many of these Communes have implemented the PCS plans.

The number of PCS that have been completed in France is difficult to ascertain. The law requires the local communities to submit a Plans de Prévention des Risques Naturels (PPR) detailing the risks posed by natural hazards before a PCS can be produced. A PCS must be produced at least two years after the

PPR is approved. It is estimated that approximately 5,000 communes in France should already have started or completed their PCSs and that approximately 10,000 PCSs will be required in total.

The PCSs aim at assisting the local level authorities in preparing the management of an emergency. PCSs cover all types of emergencies not just floods. The connection between both the PCSs and ORSEC plans is not always clear. Different actors do not necessarily agree on the thresholds that trigger particular actions. The communes in the Gard Département in the south of France have progressed their production of PCSs faster than many other Départements. However, even here the distribution of the plans is “patchy” as Figure 2.5 shows.

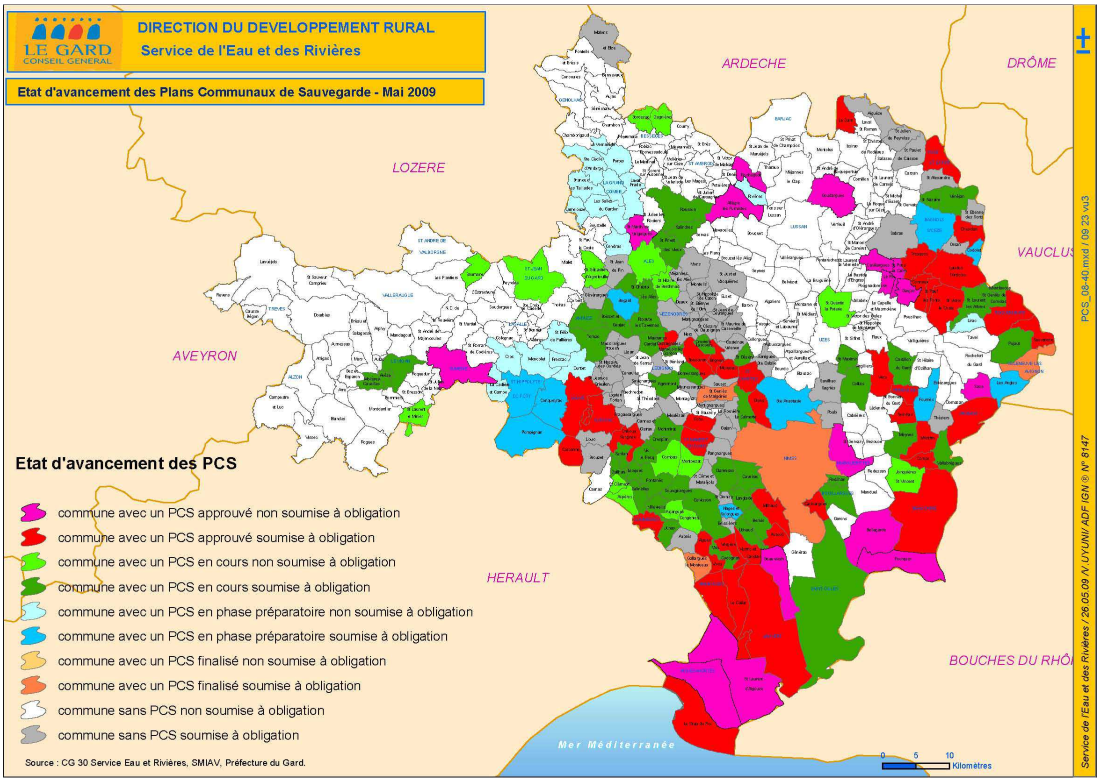


Figure 2.5 The communes that have prepared a PCS in the Gard Département of France

2.3.4 *Relationship between different plans*

The PCS is the first plan that is put into action when an emergency occurs. The PCS is activated by the mayor of each Commune and his employees. When the emergency becomes too difficult or large to handle for local authorities, the ORSEC plan complements the PCS, setting out rescue and evacuation strategies. The ORSEC plans have been in place in one form or another for 50 or so years. The legislation for the preparation and implementation of PCSs has only been in place since 2005. There appears to be little accountability regarding the PCS plans at a national level. There are only a limited number of Départements, such as the Gard, that have determined how many PCS plans have been completed.

2.3.5 Plan Particulier D'Intervention (PPI) - Emergency plans for specific installations

In France there are also emergency plans called Plan Particulier D'Intervention (PPI). These are plans for particularly sensitive installations such as nuclear power plants and chemical facilities. The requirement for a PPI is decided by the Départémental State officer (Préfet). The Communes have to include the requirements of the PPI in their Plan Communal de Sauvegarde (PCS). The requirements of the PPIs are also integrated in the ORSEC plans.

In terms of flooding PPIs are required for a dam when it has a storage capacity of over 15 millions m^3 or is over 20 m high. Before a PPI for a dam is prepared the owner of a dam needs to establish:

- The consequences of a dam break;
- Methods for monitoring the dam;
- A warning system for the downstream population, and other receptors;
- There is also a requirement to put in place an inventory of facilities such as chemical plants that if flooded could result in another hazard.

Électricité de France (EDF) operates some 200 dams in France and has PPIs in place for around 70 of them.

2.3.6 Types of floods planned for in France

In France, emergency plans such as the PCS and ORSEC plans are supposed to address all kinds of floods including: slow-rising fluvial floods, coastal surges, flash floods and the failure of flood defences. ORSEC plans are drawn up at a Département level; hence they are only used in the case of floods that cover a wide spatial area. One of the reasons for the introduction of PCS plans is that the more generalised flood incident management plans actually did not address local flooding. As a consequence PCS plans often focus on the management of urban flooding as well as flash floods and fluvial flooding. Although coastal floods do occur they are generally not addressed in emergency plans. This is because coastal flooding is not one of the major sources of flooding in France. There are ORSEC maritime plans; however, these focus on incidents at sea (e.g. ship wrecks and aircraft crashes) and pollution incidents.

2.4 Background to emergency planning for floods in the Netherlands

2.4.1 Local emergency plans

In the Netherlands safety is legally defined as a local responsibility. The main responsibility of preparing for flooding lies with the municipalities. This is regulated by the 2004 Act "Improvements in the emergency management" (Wet Kwaliteitsbevordering Rampenbestrijding, (WKR)). Local authorities (municipalities) are obliged to formulate emergency management plans for the potential risks within their area. Three types of plans are required; a general emergency management plan which focuses mainly on the organisation, responsibilities, duties and authorities of the different institutes and officials and, depending on the nature of the risk, a disaster plan or a coordination plan. A disaster plan covers "static risks" which is defined as a risk for which location, nature and outcome can be foreseen. The act sets out a list of aspects to be covered by a disaster plan. Coordination plans should be drawn up for incidents on waterways, roads, rail, nature reserves and cross border regions. The act does not specify aspects to be covered by a coordination plan. Flood risk is covered by both coordination plans and disaster plans as it is not clear by which type of plan a flood event should be covered by. Often flood risks are addressed on a regional scale via the cooperation of several municipalities and agencies involved in event management or within the context of a Safety Region, whichsis discussed below. This is due to the fact that the extent of a flood almost always exceeds the municipality boundaries.

2.4.2 The Safety Regions

A Safety Region is a regional cooperation of municipalities, police, fire brigades and health care organisations. In 2006/2007 a Government bill entitled the “Safety Region Bill” was submitted for the establishment of the “Safety Regions”. As of January 2010 the act was still under discussion. If the Bill is approved, 25 Safety Regions should be operational by the end of 2010. In many areas Safety Regions have already started emergency planning in advance of the approval of the Safety Region Act. The draft act states that the Safety Regions prepare for risks by first performing a risk inventory. In addition three plans need to be drawn up:

- A policy plan which formulates the organization of the regions’ event management;
- A crisis plan which is a generic plan (applicable to all types of risks) on operations for disasters and crises;
- A disaster plan which is only obligatory for airports and institutes with a high risk of causing a disaster.

This implies that the act does not dictate that disaster plans are drawn up for regional risks such as flooding. However, in the context of the TMO, Safety Regions (or if not yet initiated a cooperation of neighbouring municipalities and agencies), have drawn up flood disaster plans. These plans have not been produced using a fixed format or according to guidelines. It should be noted that not all Safety Regions will need to deal with flood risks or only to a limited extent.

2.4.3 The Water Boards

Preparing for flood events on a local and regional scale has traditionally been the responsibility of the Water Boards. The Water Boards focus mainly on their field of responsibility which is the monitoring of water levels, prevention of failure of defences, implementation of measures to prevent or limit flooding and provision of information. This was legally defined in paragraph 17 of the Water Administration Act of 1900 which dealt with the ‘provisions for preparation and acting in case of danger’. The Water Boards have been obliged to draw up emergency plans. Such a plan includes an inventory of the kind of emergencies that may happen and their potential risks, the measures to be taken, the required equipment and the services to be provided by different institutions. The plans also include:

- The organization of the water manager emergency response team;
- The warning and reporting procedures;
- The quality assurance of the plan.

A new act, the Water Act (Waterwet), was passed in December 2009. The Water Act aims at preventing and, where applicable, limiting floods and drought. It replaces the Water Administration Act. The new Water act also states the formulation of a calamity plan by the water managers. The act does not define specifically the aspects to be addressed, but does put an emphasis on being consistent with the municipality and Safety Region emergency plans.

2.4.4 *National emergency plan*

The threat of a coastal or a large fluvial flood will often be dealt with on a national level. This process is described in the National Response Plan. This plan focuses mainly on the organization, responsibilities, duties and authorities of the different institutes and officials, operations and communication.

2.4.5 *Relationship between different plans*

A flood threat starts when a warning water level has been exceeded. The first stage is activated at which responsibility and coordination is on a regional level. Four stages are defined which are linked to warning water levels. The responsibility shifts from a regional to a national level from the third stage onwards, although the regional parties are still responsible for assistance on operational aspects. The National Response Plan describes the organization and responsibilities of all four stages. An overview of event planning in the Netherlands is shown in Figure 2.6.

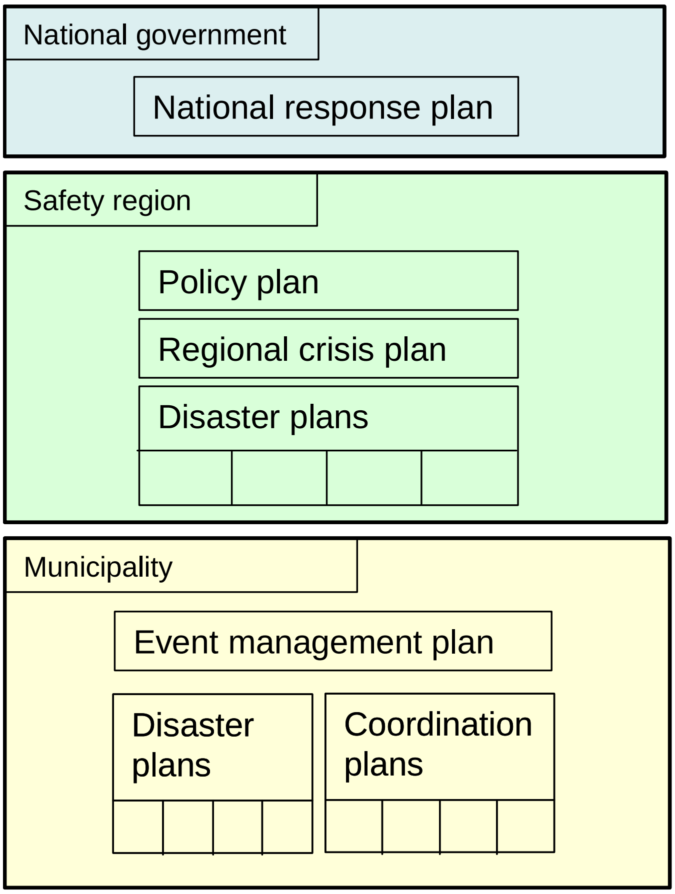


Figure 2.6 Overview of emergency planning in the Netherlands

2.4.6 *Type of floods planned for in the Netherlands*

The Netherlands is a delta area bordered by the sea on the west and crossed by the River Meuse and the River Rhine. A large part of the Netherlands, approximately 25%, lies below sea level and an even larger area, approximately 55% is susceptible to flooding from river and sea. In addition, floods can occur from regional waters such as free flowing streams, brooks, canals and urban drainage systems. Regional flooding is mostly considered to be of a low impact compared to other floods and it is therefore expected that less attention is given to the preparation for these types of floods. It is only recently that as a result of the Floods Directive, Water Boards have started to systematically map the flood risks for regional floods. Owing to the terrain of the Netherlands, flash floods are highly unlikely and there are also no large dams.

The areas susceptible to flooding are protected by flood defences. These defences form rings protecting the land within the ring against flooding from the rivers and sea. The safety standards for the dike rings are very high ranging from 1 in 250 to 1 in 10,000 years. The safety standard is related to the economic activity, assets and the number of inhabitants threatened by floods within the dike ring. If a flood were to occur, the impact of flooding could be very high due to the fact that the majority of inhabitants and the main economic centres lie within flood susceptible areas. The potential flood extent, dike rings and Safety Regions are shown in Figure 2.7.

Dike rings differ from each other and this suggests that emergency planning for floods will also differ. One of these differences is the forecast lead time. A coastal flood has a forecast lead time of 24 to 48 hours, whereas the forecast lead time for a fluvial event is in the order of five days. From flood model simulations it can be seen that water depths resulting from a fluvial flood are also larger than for coastal floods. The dike rings along the main rivers are deep and relatively small compared to the dike rings along the coast. Water depths of up to 6 m can be reached.

2.5 Differences and similarities in emergency planning for floods in England and Wales, France and the Netherlands

In all three countries there has been legislation passed in the past five or six years that has acted as a catalyst for the production of emergency plans. In England and Wales and the Netherlands Acts of Parliament passed in 2004 have provided an impetus to the formulation of emergency plans and in France an Act passed in 2005 paved the way for the production of local level emergency plans.

In all three countries the “basic” or “reference level” for emergency planning is the responsibility of local government. Although regional and national flood emergencies cannot be managed exclusively at a local authority level, “*the essential remedy to an emergency situation is almost inevitably applied at a local scale*” (Drabek and Hoetmer, 1991). In the Netherlands, planning is often dealt with on a regional level due to the expected extent of flooding. In all three countries there is a hierarchy of emergency planning with national, regional and local plans. There is a “shift” in responsibility from local to regional to national level as the spatial extent of a flood event increases. There often appears to be a “disconnect” or “overlap” between the local, regional and national emergency plans in all three countries in terms of emergency planning. For example in France, it is estimated that some 10,000 local emergency plans will be produced. However, it is not always clear how well these connect with regional level plans. In England and Wales Multi-Agency Flood Plans do not always mention the link to other emergency response plans that include complementary information.

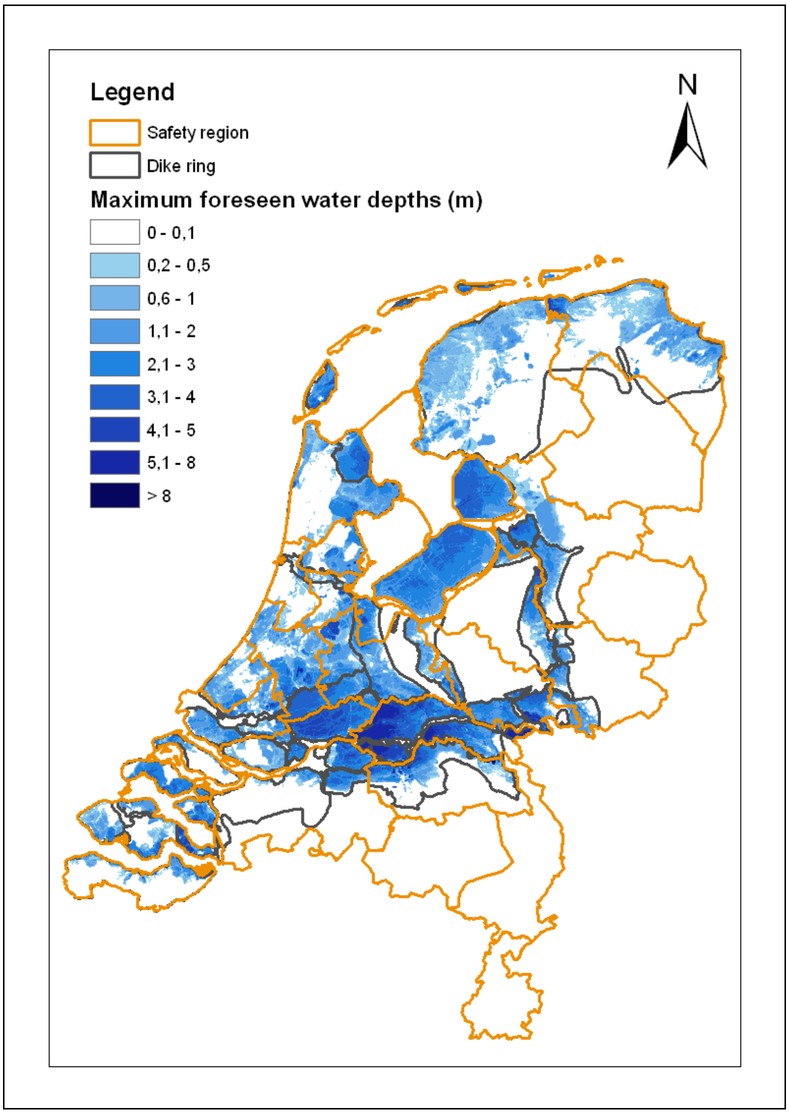


Figure 2.7 Water depths, safety regions and dike rings in the Netherlands

The production of emergency planning for floods in all three countries at a local level is a relatively new phenomenon. The local authorities who some times have limited capacity in emergency planning and emergency responders (e.g. fire brigade, police and ambulance service) who often do not have the expertise in flooding, are now faced with having to prepare for floods. This requires cooperation between the local services and authorities and experts on flooding. In England and Wales and in the Netherlands cooperation is organised through the organised collaboration of the different agencies involved (the Local Resilience Forums and the Safety regions).

For all three countries a generic plan focuses on strategic planning covering issues such as organisation and responsibility, communication and evacuation. These plans cover other risks besides flooding. In England and Wales and the Netherlands underlying plan(s) focus on flooding. In France, unlike in England and Wales and the Netherlands, there are no emergency plans that focus specifically on flooding. The plans in France focus on a range of different hazards, including technological hazards, although in many areas flooding is the most important hazard.

In both France and England and Wales there are guidelines in place to assist emergency planners at a local level produce these plans. In France these guidelines have been in place since 2005 and in England and Wales since 2008. It is important to note that there is no fixed format for plans in France and England and Wales and this leads to a variation in length and quality of the plans which is discussed in Chapter 4. For the Netherlands no guideline exists for the production of emergency management plans.

With the possibility of some 10,000 local emergency plans being produced, France out of the three countries in the project has the most localised level of emergency planning. It is also the country where there appears to be the greatest “disconnect” between the local level plans and the regional and national level plans.

3 Development of metrics to assess flood emergency plans

3.1 Introduction

Recent decades have seen significant increases in the number, scope and complexity of incidents and disasters. It is now generally agreed that places that are significantly at risk of hazards should be required to construct emergency plans (Alexander, 2005). Research carried out by Alexander (see Alexander, 2002, 2003, 2005) has found that there is an "*enormous variety and lack of homogeneity*" amongst emergency planning documents in many parts of the world. Alexander postulates that this implies that there is "*a shortage of adequate standards* [or metrics] *for creating, evaluating and approving emergency plans*" and that "*virtually no appropriate standards seem to exist*" (Alexander, 2005). Alexander also found that there was little in the way of metrics via which the "*fitness for purpose*" of emergency management plans can be developed.

This chapter briefly details the developments of metrics with which various elements of the plans in the three countries could be assessed. These metrics have been applied to evaluate emergency plans in the three countries to give an insight into the differences and similarities between the countries and the level of detail and emphases within the plans. The evaluation of the emergency plans also acted as a test for the applicability of the developed metrics. In addition the survey questions have been drawn up on the basis of the developed set of metrics.

3.2 Requirements of metrics

A metric may be defined as "*A measure for something; a means of deriving a quantitative measurement or approximation for otherwise qualitative phenomena*". Many emergency managers have expressed a need for metrics and guidance as they are often uncertain about the quality and appropriateness of their plans (Alexander, 2005). Many of the consulted stakeholders, who are responsible for formulating emergency management plans for floods, indicated that guidance concerning how their plans should be formulated and how they can measure if they are "fit for purpose" would be useful. Evaluation of flood emergency plans can assist in identifying strengths and weaknesses in different approaches, as well as aid in documenting improvements (or deteriorations) made over time.

The set of metrics developed had to be:

- Applicable to all the countries taking part in the research;
- Be able to be applied to emergency plans for floods at a range of geographical scales ranging from a regional to local level;
- Generic but at the same time be clear and focused to avoid misinterpretation;
- Measurable;
- Realistic given the various constraints related to emergency planning.

3.3 Description of the developed metrics

The metrics that were developed are given in Table 3.1. These metrics were developed following a review of a wide variety of emergency plans and limited guidance that currently exist, as well as consultation with a range of stakeholders in the three countries.

The metrics allow for the plans to be "scored" in a quantitative manner. For example a score of "1" would be given for a metric where the level of detail is low"; "2" where the level of detail is medium and "3" where the metric is treated in a high level of detail. By averaging the metric scores, an overall score of a plan can be obtained. In addition the average score *per metric* for the evaluated plans gives an insight into which metrics are addressed within the plans and to what level of detail. The average scoring range for the developed metrics was divided into five equally distributed bands between a score of 1 and 3. These scoring bands are given in Table 3.2. The descriptions of the scores are based on the judgement of the project team. It is important to note that whether an emergency plan is "acceptable" will be based on an individual assessment.

Table 3.1 Generic metrics for the assessment of flood emergency plans in England and Wales, France and the Netherlands – Part 1

Metric	Level of detail		
	Low	Medium	High
Objectives, assumptions and target audience			
Aims and objectives of plan	Not detailed	Aims and objectives included but could be clarified further	Clearly stated aims and objectives including the area covered, types and sources of flooding
Target audience and updating of the plan	Not detailed	Audience defined and plan dated	Audience defined and how they will be notified of updates and modifications to the plan included
Assumptions made by the plan	Not detailed	Covers some aspects	Covers all aspects including: flood warning lead time; method by which rescue will be undertaken; implications of the failure of critical infrastructure
Organisation and responsibilities			
Actions, roles and responsibilities	Not detailed	Brief details of the roles and responsibilities related to the activation of the plan provided	Details of the roles and responsibilities related to the activation of the plan provided including health and safety and environmental considerations
Recovery	Not detailed	Brief details of how the recovery is managed	Details of how the recovery is managed including clean up, waste disposal, repairs to public assets, humanitarian assistance
Training and exercises	Not detailed	Brief details of training and exercise requirements	Internal and external (with other organisations) training and exercises outlined
Plan activation	Not detailed	Brief description of the thresholds or levels used to activate plan	Description of the thresholds or levels used to activate plan together with flow chart
Communication			
Communication with other agencies	Not detailed	Outlined in words	Detailed and the links shown diagrammatically
Communication with the public	Not detailed	Outlined in words	Detailed and shown the links shown diagrammatically
Management of the media	Not detailed	Outline media management strategy in place	Well defined media management strategy in place
Flood warning (if available)	Undefined	Levels of flood warning with details of the areas flooded at each level	Levels of flood warning with details of the areas flooded at each level and shown on a map
Relationship with complementary emergency plans detailed	Not detailed	Outlined in words	Detailed and the links shown diagrammatically

Table 3.1 Generic metrics for the assessment of flood emergency plans in England and Wales, France and the Netherlands – Part 2

Metric	Level of detail		
	Low	Medium	High
Evacuation			
Evacuation routes	Not detailed	Evacuation routes shown on a map	Evacuation routes detailed together with roads likely to be closed and their accessibility for emergency vehicles and other vehicles
Shelters/Safe havens	Not detailed	Safe havens/shelters shown on a map	Safe havens/shelters shown on a map with their capacity and facilities
Flood hazard			
Flood hazard map	Not detailed	Flood hazard map(s) showing extent	Flood hazard map(s) showing water depth and velocity
Details of previous floods (if available)	Not detailed	Brief description of historical flood	Description of historical floods with the cause and a brief description of the risk in terms of people and properties affected
Flood risk to receptors			
Flood risk to people	Not detailed	Number of people potentially affected included	Potential injuries and loss of life included and mapped for a range of scenarios
Flood risk to vulnerable people (e.g. elderly or disabled)	Not detailed	Areas where elderly/sick people live mapped	Numbers of vulnerable people defined with a response strategy
Flood risk to residential property	Not detailed	Number of properties defined	Number of properties defined together with those at risk of collapsing during an extreme flood
Flood risk to businesses	Not detailed	Number of businesses defined	Number and type of businesses defined together with potential losses
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	Not detailed	Number of pieces of critical infrastructure shown on the flood map(s)	Number of pieces critical infrastructure shown on the flood map(s) and an assessment of their likelihood of failure during a flood
Potential for NaTech hazards at industrial facilities (if present)*	Not detailed	Potential NaTech sites shown on map	Potential NaTech sites shown on site and brief details of the response

*Note: A NaTech is defined as technological hazard that is triggered by a natural hazard. For example the flooding of an industrial plant may lead to the release of a toxic chemical that poses a threat to humans, as well as flora and fauna

Table 3.2 Scores for the emergency plan

Average score	Average quality	Description to determine the quality of the flood emergency management plan
2.6 to 3.0	Good	There is little or no further information that could have been included in the plan(s). This can be considered as a ‘Good’ score with little room for improvement.
2.2 to <2.6	Above average	There is some further information that could have been included in the plan(s). This could be considered an “Above average” score.
1.8 to <2.2	Average	Considerably more information could have been included in the plan(s). This could be considered an “Average” score.
1.4 to <1.8	Room for improvement	There is information missing from the plan(s). There is “Room for improvement”.
1.0 to <1.4	Considerable room for improvement	There is a large amount of additional information that could be included in the plan(s). There is “Considerable room for improvement”.

4 Review of emergency flood plans in England and Wales, France and the Netherlands

4.1 Introduction

This chapter provides the results of the review of the flood emergency plans that have been collected by the project team in England and Wales, France and the Netherlands. The plans were reviewed using the metrics that have been developed by the project team and which are detailed in Chapter 3. The average scores for each metric were calculated as well as an average for each emergency plan. The objectives of this exercise were:

- To assess which metrics are being addressed in emergency plans and to what level of detail;
- To assess the differences and similarities of emergency planning across the three countries.

It should be noted that some of the plans may have been updated since the review was performed. However, it was felt that it was a valid exercise to apply the metrics to plans even if they are "out of date" or a draft version because it demonstrates the adequacy of the plan at the time it was written and if a later revision of the plan becomes available then it may allow a comparison to be made at a later date.

The plans were obtained via several routes:

- Direct contact with and requests to relevant stakeholders such as the Environment Agency in England and Wales; mayors in France and Safety Regions in the Netherlands;
- Literature searches;
- Downloaded from the internet.

This chapter provides a summary of the results. It focuses on the score per plan and on the score per metric. For each country an overview of the average score per metric is provided. Colours have been used to indicate to which "metric group" the metric belongs. The colour code is shown in Table 4.1.

Table 4.1 Colour coding for the metric groups

Metric group	Colour code
Objectives, assumptions and target audience	
Organisation and responsibilities	
Communication	
Evacuation	
Flood hazard	
Flood risk to receptors	

Detailed reviews of each of the plans available to the team at the beginning of April 2010 for England and Wales, France and The Netherlands are provided in Appendices A, B and C respectively.

4.2 Review of emergency flood plans in England and Wales

For England and Wales the focus was on Multi Agency Flood Plans (MAFPs) and 13 MAFPs have been reviewed. In England and Wales a guidance and checklist have been produced by the Environment Agency/DEFRA for MAFPs. The guidance provides advice to Local Resilience Forums in England and Wales as to what should be included in MAFPs and how a MAFP should be formulated including the use of diagrams, maps and tables. The latest versions of these are:

- Developing a Multi-Agency Flood Plan (MAFP) – Guidance for Local Resilience Forums and Emergency Planners, February 2008;
- Checklist for Multi-Agency Flood Plans (MAFPs), December 2009.

Table 4.2 provides brief details of the plans that were available to the project by the beginning of April 2010 and that were analysed using the developed metrics. The locations of the plans that were reviewed are shown in Figure 4.1. It is important to note that many Local Resilience Forums are still in the process of producing MAFPs and this together with issues of confidentiality in some cases, limited the number of MAFPs that were readily available for review.

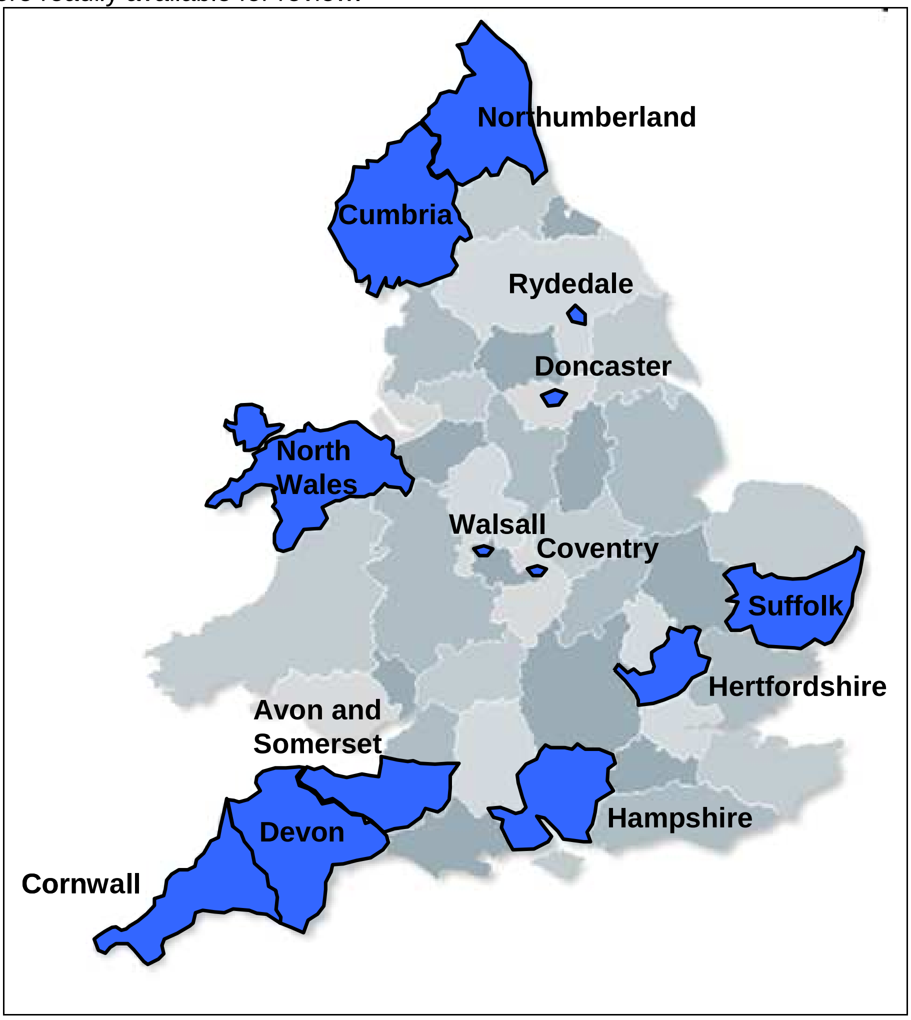


Figure 4.1 Location of the Multi-Agency Flood Plans reviewed in England and Wales

Table 4.2 List of flood emergency plans reviewed for England and Wales

Name of plan	Date of plan	Plan score	Length of plan (pages)
Cornwall Emergency Plan	January 2004	2.00	Approximately 150
Devon Emergency Plan	April 2004	2.18	Approximately 250
Hampshire Flood Response Plan	December 2007 Version 1	1.32	28
Suffolk Multi Agency Flood Plan	March 2009 Issue 2	1.45	43
Walsall Flood Plan	January 2009 Amendment 01/09	1.45	24
Coventry Multi-Agency Flood Plan	Draft 31 March 2009	1.70	46
North Wales Multi-Agency Flood Plan	Version 3 May 2009	2.16	227
Northumberland Local Resilience Forum Multi Agency Flood Plan	Consultation Draft Version 1.0 September 2009	2.32	209
Cumbria Multi-Agency Flood Plan	October 2009	2.25	300
Doncaster Multi-Agency Flood Plan	Version 5 October 2009	2.27	117
Multi-Agency Flood Response Coordination Plan - Ryedale	November 2007 Reviewed: October 2009	1.86	120
Hertfordshire Multi-Agency Strategic Flood Plan	Version 1.6 November 2009	1.34	21
Avon and Somerset	Version 1.9 December 2009	2.02	58

The average score of the MAFPs reviewed was 1.9 which rates as an "average" score using the developed metrics. The plans' scores ranged from 1.3 classed as "considerable room for improvement" to 2.3 classed as "above average"

Table 4.3 provides the average scores of the metrics for the 13 plans that were reviewed in England and Wales. It is interesting to note that of the 22 metrics that were used to evaluate the plans that no metrics ranked as being "Good", only five metrics ranked as being "Above average"; and only five other metrics produced an "Average" score.

Table 4.3 Average score of the metrics for the 13 Multi-Agency Flood Plans (MAFPs) that were reviewed in England and Wales

Metric	Average score	Average quality of the metrics
Target audience and updating	2.46	Above average
Aims and objectives of plans	2.38	
Plan activation	2.38	
Flood Warning	2.31	
Actions, roles and responsibilities	2.23	
Details of previous floods	2.15	Average
Relationship with complementary emergency plans	2.15	
Communication with other agencies	2.08	
Recovery	2.08	
Training and exercises	1.85	
Flood hazard map	1.77	Room for improvement
Flood risk to residential properties	1.77	
Management of the media	1.77	
Risk to vulnerable people	1.69	
Shelters/Safe havens	1.69	
Communication with the public	1.65	
Flood risk to critical infrastructure	1.58	
Risk to people	1.54	
Evacuation routes	1.46	
Flood risk to business	1.31	Considerable room for improvement
Assumptions made by the plan	1.35	
Potential for NaTech hazards	1.31	
Key to table - Metric group	**Colour code**	
Objectives, assumptions and target audience		
Organisation and responsibilities		
Communication		
Evacuation		
Flood hazard		
Flood risk to receptors		

It is seen that the metrics groups ''Objectives, assumptions and target', Organisation and responsibilities" and flood hazard" score around average and higher, whereas the metric groups "flood risk to receptors" and "evacuation" score below average.

Overall results from the review of the plans are given below.

(i) Impact of flooding on receptors including critical infrastructure

Although information and methods are available to assess the impact on receptors including people, buildings and critical infrastructure, this often does not seem to find its way into the MAFPs. Recent flood events in the England and Wales have highlighted the need to assess the vulnerability of critical infrastructure such as electrical sub-stations, wastewater and water supply infrastructure and gas pipelines. There are many MAFPs that do not show the location of critical infrastructure in the floodplain and there are none that give the probability of inundation of these pieces of infrastructure, or the probability of failure of these pieces of infrastructure as a result of flooding.

Although many of the MAFPs provide details of the potential number of people located in the floodplain, none of the MAFPs reviewed provided any details of the risk in terms of the potential number of people injured. There is also little information given on the risks to businesses, although this may be because emergency planners do not see these as their main priority in planning for flood emergencies.

(ii) Evacuation and shelters

There are few plans that indicate evacuation routes. This may be because they are thought by emergency planners to be “obvious”, which is not always the case, because they are included in local plans or because they are simply not thought of as being important. However, in many heavily defended areas of England and Wales these routes will be important. Failure of coastal flood defences, as happened in the 1953 floods, could put 100,000 of people at risk and could call for a mass evacuation. There are several coastal areas and heavily defended urban areas, such as London, where it is not clear if the options for and time required to undertake evacuations for flood events have been assessed.

Plans often have details of shelters and rest centres; however, they rarely indicate their facilities or capacity. This may be because these details are held in separate evacuation or shelter plans. However, if they are it is rarely stated in the plans that these exist.

(iii) Hazards arising from NaTechs and mapping of flood hazards

The metric that scored the lowest was the potential for NaTech hazards (i.e. other hazards triggered by flooding such as the release of toxic chemicals as a result of the inundation of a chemical facility). Of the plans reviewed only one showed the location of these potential sources of NaTech hazards in the floodplain.

Flood hazard mapping can be considered to be a “mature” technology. Most, although not all, of the MAFPs reviewed contained flood hazard maps in one form or another. However, although it is available in many areas none of the MAFPs show the flood hazard in terms of depth, velocity or a combination of these two variables. This may be because the guidance document for the preparation of MAFPs indicates that flood maps showing flood extent should suffice. Flood maps showing maximum depths, velocities or a combination of these could be of use to emergency responders in terms of potential issues with access and rescue.

(iv) Communication with the media and assumptions

Few of the plans mentioned the assumptions that had been made by the plan (e.g. extent of the flooding, implication of joint tidal and fluvial floods, rescue methods) and very few mentioned if a communication plan with the media was in place.

4.3 Review of emergency plans in France

For France the focus was on the Plan Communal de Sauvegarde (PCS) level. Fourteen PCSs were analysed using the developed metrics. For comparison, two additional plans have been assessed. These are the “Dispositif Orsec Zone de Défense de Paris” (DOZDParis) and the Plan de Decours Specialise Inondations Loire (PSSIL) which is a specific emergency plan for floods in the Loire River catchment. These have been compared with a PCS at local scale within the relevant area. An overview of the reviewed plans is given in Table 4.4.

Table 4.4 Overview of reviewed emergency plans in France

Name of plan	Type of plan	Date of reviewed version	Score of plan	Length of plan (pages)
Blagnac PCS	Plan Communal de Sauvegarde	2002 updated 2009	1.76	58
Quissac PCS	Plan Communal de sauvegarde	2006	2.19	25 plus appendices
Perpignan PCS	Plan Communal de Sauvegarde	June 2006	1.95	192 plus maps
Metz PCS	Plan Communal de Sauvegarde	September 2007	2.05	69
Brives-Charensac PCS	Plan communal de Sauvegarde	September 2007	1.95	6
Plan de Secours Spécialisé Inondation Loire	Emergency plan for the upstream part of the Loire River catchment	2004 updated 2009	1.90	23
Nanterre PCS (local emergency plan)	Plan communal de sauvegarde	2007	2.10	104 plus appendices
Le Cailar PCS	Plan Communal de Sauvegarde	October 2007	2.34	26 plus appendix
Nice PCS	Plan Communal de sauvegarde	31 October 2007	1.90	24 appendices
Cléry Saint-André PCS	Plan Communal de Sauvegarde	2009	2.41	613
Nancy PCS	Plan Communal de Sauvegarde	2009	1.33	49
Saint Raphael PCS	Plan Communal de Sauvegarde	2009	1.52	142
Piolenc PCS	Plan Communal de Sauvegarde	April 2009	1.43	122
Sommières PCS	Plan Communal de Sauvegarde	17 April 2009	2.10	87
Dispositif Orsec Zone de Défense de Paris	Regional Emergency plan region Ile-de-France	October 2009 Draft version	2.14	23 plus appendices
Tarascon PCS	Plan Communal de Sauvegarde	2006 updated in November 2009	1.84	92 plus appendices

The French Ministry of Interior and the Institute of Major Risks (Institut des Risques Majeurs (IRMa)) in Grenoble have both developed separate guidelines and checklists to assist emergency planners in formulating PCSs. As a consequence PCS plans tend to have similar contents although the quality was found to vary. The versions of the PCS that were reviewed were the latest available versions. The location of the emergency plans reviewed is shown in Figure 4.2.

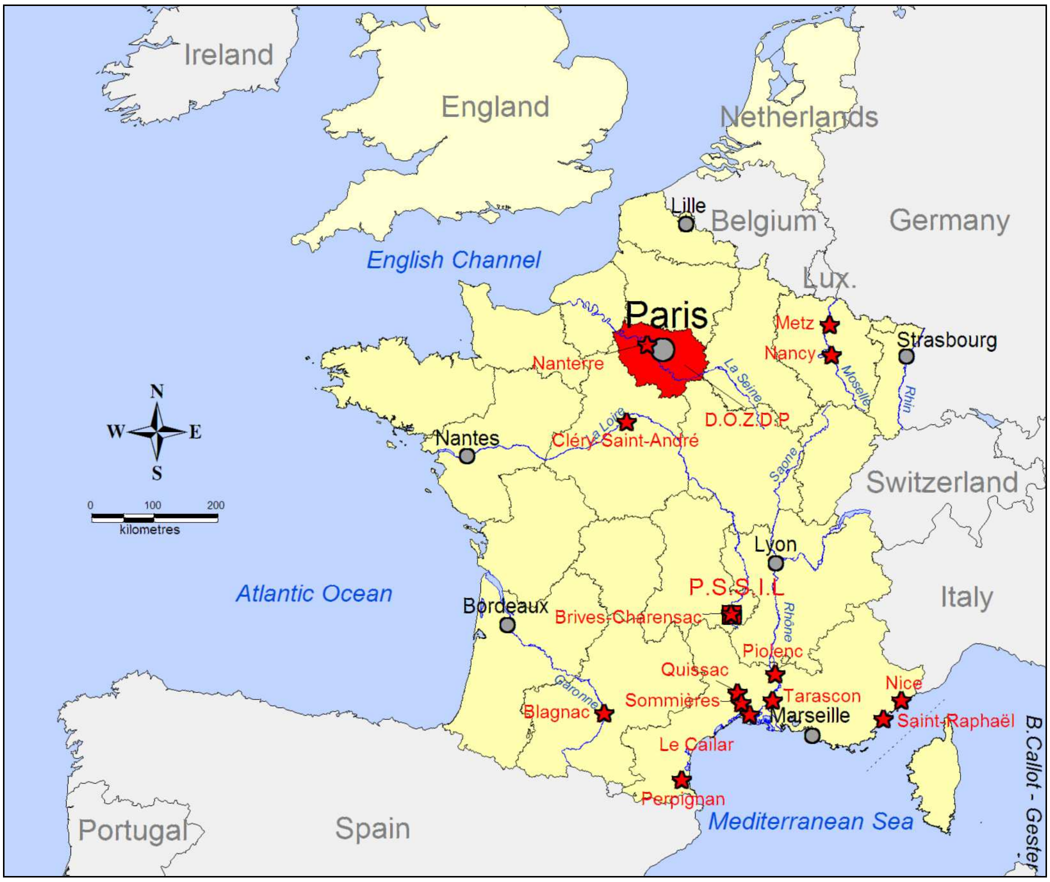


Figure 4.2 Location of the emergency plans reviewed in France

The average score of the PCSs reviewed was 1.9 which rates as an “average” score using the developed metrics. The plans’ scores ranged from 1.1, classed as “considerable room for improvement” to 2.4 classes as “good”. There was not a clear correlation between the score of a plan and the date when the plan was produced or the length of the plan.

Table 4.5 provides the average scores of the metrics for the 16 plans that were reviewed in France. Of the 22 metrics that were used to evaluate the plans, only one metric, “plan activation”, ranked as being “good” and only six other metrics produced an “above average” score.

Table 4.5 Average score of the metrics for France

Metric	Average score	Average quality of the metrics
Plan activation	2.56	Good
Actions, roles and responsibilities	2.54	Above average
Communication with other agencies	2.44	
Communication with the public	2.25	
Flood Warning	2.29	
Flood hazard map	2.25	
Target audience and updating	2.20	
Shelters/Safe havens	2.13	Average
Aims and objectives of plans	2.00	
Potential for NaTech hazards	1.94	
Relationship with complementary emergency plans	1.86	
Flood risk to critical infrastructure	1.81	
Flood risk to residential properties	1.80	
Details of previous floods	1.78	Room for improvement
Training and exercises	1.78	
Risk to people	1.72	
Management of the media	1.67	
Assumptions made by the plan	1.57	
Evacuation routes	1.60	
Recovery	1.56	
Flood risk to business	1.50	
Risk to vulnerable people	1.44	

Key to table - Metric group	Colour code
Objectives, assumptions and target audience	
Organisation and responsibilities	
Communication	
Evacuation	
Flood hazard	
Flood risk to receptors	

Table 4.5 shows that the higher scores (above average and good) are mainly scored by the metrics of type “organisation and responsibilities” and “communication”. Metrics of relating to “Objectives, assumptions and target audience” score around average.

The lowest scores were for the metrics in the category “Flood risk to receptors”. Some metrics that are not covered by PCSs are often included in other documents such as the Plan de Prevention des Risques (PPR) which provides information on the receptors that are at risk from flooding. However, PPRs are used primarily as a development control measure and only 8,000 communes out of 20,000 communes that are exposed to flooding in France are covered by a PPR. When the combined score of a plan at local level (PCS) together with regional level plan was undertaken the combined score was higher than the score of the local emergency plans. It means that some aspects of emergency planning which are not addressed by PCS are covered by others plans at an upper geographical scale. However, there is often a “disconnect” between these plans.

Overall results from the review of the plans are given below.

(i) Organisation and responsibilities

PCS and ORSEC plans have to conform to legal requirements and guidelines. As a consequence the plans are focused on the management of the emergency itself rather than the identification of risk. This explains partly why the metrics that are related to organisation and responsibilities often have a high score and on the other hand the metrics related to receptors at risk (e.g. people, buildings) often have low scores.

The combination and the coordination of plans at different levels are supposed to enhance the effectiveness of the emergency response. For example, the emergency management of networks may be dealt with at a regional level, whilst the issue of evacuation depends on the population in flood prone areas and the available routes. It may be that the communal level of emergency management is too detailed and that there is a requirement for another level of emergency management. The tradition of emergency planning at a national and regional level in France is well developed. The production of PCSs is relatively recent and this may explain the “disconnect” between the plans and the room for improvement. An example of this disconnect is seen for the alarm triggering levels for the city of Sommières as illustrated in Figure 4.3 that are different in the PCS .

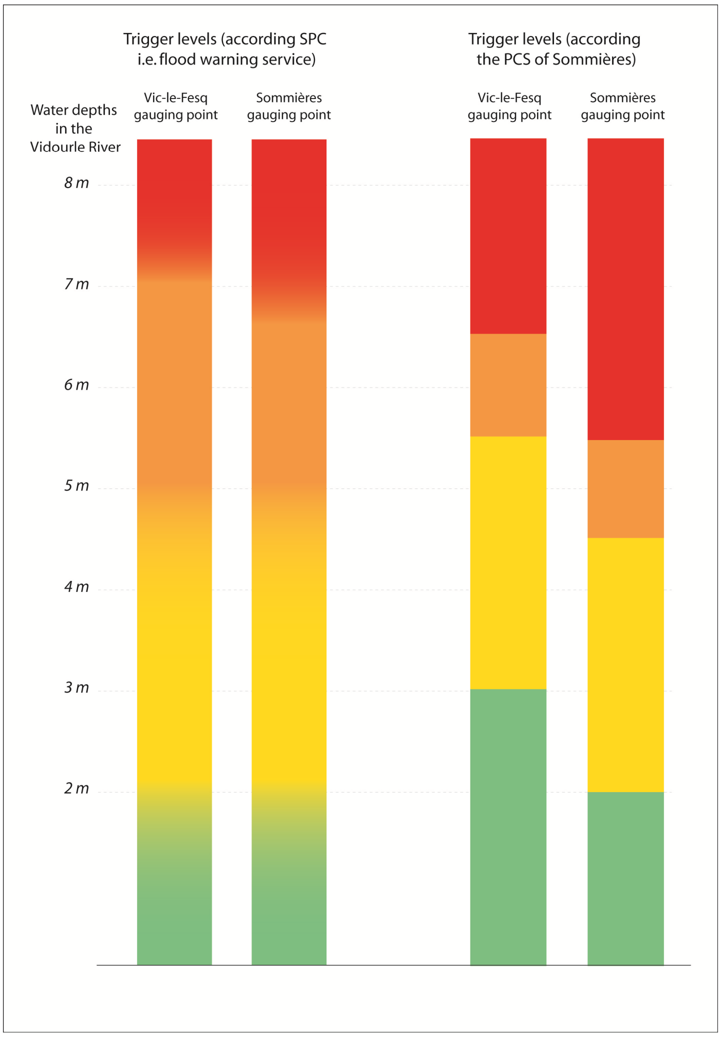


Figure 4.3 Differences in warning trigger levels between the flood warning service and the PCS for the communes of Sommières

The post emergency recovery is often not developed in plans except for mentions of assisting homeless people and providing psychological assistance. There was little written in the plans concerning clean up, waste disposal or repairs to public assets. This points to a shortcoming in dealing with the emergency recovery in France.

(ii) Communication

PCSs are becoming more readily available on the internet. However, the online versions are often shorter than the full plan. In many cases the appendices and relevant maps are not disseminated to the population except as a hard copy that is only available at the town hall. There are two ways of addressing the involvement of the public:

i. Municipal authorities consider that emergency is their own responsibility. In this case the people are only informed as the law requires.
ii. The population is clearly involved. In this case, citizens can relay the messages of authorities in the different part of the city. Exercises are planned to involve and to inform the population.

The first case is the one that occurs most frequently. In some communes, the floods are so frequent that authorities think that an exercise is not necessary. However, dissemination of information to the population is being addressed. Prior to 2005, the Document d'Information Communal sur les Risques Majeurs (DICRIM) defined a method to inform the public of the risks in their commune. The DICRIM has been integrated to PCS as a form of dissemination.

The scores are also generally low for the management of media. There is room for improvement in this field and in France there have been some examples of municipal councils that have lost elections owing to poor communication during an emergency.

(iii) Evacuation

Evacuation is not well addressed by the plans that were reviewed. No plan contained an evacuation map. This may be due to the fact that evacuation is not really a responsibility of municipal authorities. Many mayors think that this is the state's responsibility. However, the key question of the responsibility of evacuation is unclear.

(iv) Flood hazard

Many plans lacked relevant maps. Flood hazard maps were frequently included but in a basic form. The flood zone is shown but depth data is rarely shown. Flow velocities did not appear and neither did major flow routes. There is often useful information on the flood hazards and previous floods contained in the Plan de Prevention des Risques (PPR); however, the PCSs often do not refer to these plans. Flood warning levels are generally well defined. However, in several plans, the intermediary levels of flood are not addressed.

(v) Flood risk to receptors

Risk to vulnerable people (1.4) and risk to business (1.5) were the lowest scoring metrics. This was a shortcoming in all the PCSs reviewed. There is a lack of:

- Maps of vulnerable people, although PCSs often include lists, which are not in the public domain, detailing shelters, vulnerable people or resources for emergency management such as food, blankets and drinking water.
- Assessment of the assets that are at risk.

The PCSs are produced in order to save human lives and to minimize the failure of public infrastructures. The protection of goods and property is not considered as a major objective owing to the French national insurance system that covers damage to properties and businesses that occurs as a result of natural hazards.

4.4 Review of emergency plans in the Netherlands

The review of the Dutch emergency plans focused on the regional plans developed by either a cooperation of municipalities and services or by a Safety Region. Eleven regional plans were reviewed; in addition the National Response Plan was reviewed as well. Of the 25 planned Safety Regions in the Netherlands, three regions are not threatened by floods. These regions might prepare for the sheltering of evacuees though, but such plans were not considered for this research. An overview of the reviewed plans is given in Table 4.6. Figure 4.4 shows the regions for which plans were reviewed.

Table 4.6 List of flood emergency plans reviewed for the Netherlands

Name of plan	Type of plan	Date of plan	Plan score	Length of plan (pages)
Plan 1	Safety Region plan	Version 1.0, 5 June 2007	2.32	286
Plan 2	Safety Region plan	26 March 2009	1.82	76
Plan 3	Safety Region plan	May 2009	1.64	109
Plan 4	Safety Region plan	Version 1.0, 3 December 2008	2.23	88
Plan 5	Safety Region plan	Version 3.0, November 2009 (draft)	1.73	54
Plan 6	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	15 September, 2005	1.77	188
Plan 7	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	Version 1.1, 14 August, 2007	1.23	41
Plan 8	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	Version 2, 1 October 2007	1.45	31
Plan 9	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	Version 2.3, December 2009 (draft)	1.33	36
Plan 10	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	August 2008 (draft)	1.59	55
Plan 11	Safety Region plan	February 2010 (draft)	1.64	57
National Response Plan	National Response Plan	August 2008	1.55	157

Figure 4.4 Availability of emergency plans for Safety Regions in the Netherlands

The average score of the regional plans (thus excluding the National Response plan) reviewed was 1.7 which rates as a "room for improvement" score using the developed metrics. The plans' scores ranged from 1.2, classed as "considerable room for improvement" to 2.3 classes as "above average". No relation was found between the age of the plan and the score. The two plans that scored "above average" are from 2007 and 2008. The lowest scoring plan was drawn up in 2009; however, this was a draft version.

The disaster management plans in the Netherlands are very diverse. Final as well as draft plans exist, and some plans are produced by a Safety Region while others are drawn up with the cooperation of parties such as Water Boards, municipalities and the fire brigade. This diversity in the parties involved in the production of the plans is probably due to the fact that the establishment of Safety Regions as well as the responsibility for the production of emergency plans by the Safety Regions is still under discussion.

The plans which are developed by the Safety Regions scored higher than the plans drawn up by a cooperation of regional parties. The plans drawn up by the Safety Region are longer and show a more uniform format and layout than the regional plans. The quality of the plans also seems to be related to the area the plan covered. For example, the plans formulated for areas with a high number of inhabitants or high economical value generally scored higher and covered more aspects than those where the level of risk was lower.

In general it can be said that the look and content of the reviewed plans differed greatly. This is due to the fact that in the Netherlands no guidelines or predefined format is made available to planners. It was seen though that some plans have similar layout and addressed the same items.

Table 4.7 provides the average scores of the metrics for the 11 plans that were reviewed in the Netherlands.

Table 4.7 Results metrics for the review of the Dutch flood emergency plans

Metric	Average score	Average quality of the metrics
Aims and objectives of plans	2.58	Good
Flood hazard map	2.25	Above average
Plan activation	2.25	
Actions, roles and responsibilities	2.25	
Communication with other agencies	2.18	
Communication with the public	2.17	
Flood Warning	1.83	Average
Target audience and updating	1.92	
Risk to people	1.83	
Evacuation routes	1.75	
Management of the media	1.67	Room for improvement
Assumptions made by the plan	1.67	
Training and exercises	1.50	
Relationship with complementary emergency plans	1.58	
Flood risk to critical infrastructure	1.42	
Potential for NaTech hazards	1.33	Considerable room for improvement
Shelters/Safe havens	1.33	
Risk to vulnerable people	1.25	
Flood risk to residential properties	1.17	
Flood risk to business	1.17	
Details of previous floods	1.08	
Recovery	1.08	

Key to table - Metric group	Colour code
Objectives, assumptions and target audience	
Organisation and responsibilities	
Communication	
Evacuation	
Flood hazard	
Flood risk to receptors	

Metrics of falling into the category of “Objectives, assumptions and target audience” and “Communication” generally scored “Average” or higher. Metrics relating to “organization and responsibility”also scored relatively highly. Metrics relating to “Evacuation” and “Risk to receptors” generally scored below average.

(i) Objectives, assumptions and target audience

The metric “Aims and objectives” was well defined in the Dutch plans. The aim of the plan was extensively described. The assumptions made by the plan were often not addressed.

(ii) Organisation and responsibilities

Much emphasis was given to “Actions, roles and responsibilities”. However, some plans had low scores for this metric owing to the fact that detailed descriptions of the different roles are often part of related plans.

Some of the plans did not include all the metrics. Reference was made to other plans where these metrics were said to be covered. During an event it will be crucial for the effective management of the event for the referenced plans to be readily available to the planners. The relationship with other plans had a low score. Often a reference was made to other plans, but the location of these plans and other relevant details were not included.

Training and exercise is often described in minimal detail or not mentioned at all; little attention is given to the aspect ‘recovery’.

(iii) Evacuation

Evacuation routes and shelters/safe havens are often described in minimal detail or not mentioned at all. However, in many plans the evacuation of cattle and pets is included. Large areas susceptible to flooding are farm land and house significant numbers of cattle.The evacuation of animals needs to be taken into account. In one plan it is stated that people should gather in libraries and schools. However, no map was included showing the location of schools and libraries, neither was the capacity of these locations included or the location in relation to the flood risk.

(iv) Flood hazard

A map of flood extent was almost always a part of the plan. Some plans also include water depth and velocity maps, although some only show the temporal propagation of the flood. Little attention is given todetails of previous flooding. This may be because many areas in the Netherlands have not encountered flooding for several decades.

(v) Flood risk to receptors

For the metric ‘Risk to people’ the number of people threatened by flooding was mentioned, but an extensive evaluation of casualties and loss of life was not performed. The flood risk to critical infrastructure was often described extensively in the text. Maps showing this information were lacking, which resulted in a lower score for this metric. NaTech hazards are often described in minimal detail or not mentioned at all. Aspects which require detailed and expert evaluation e.g. flood risk to residential property and businesses and risk to vulnerable people score low.

4.5 Validation of the metric scores

In order to assess the “subjectiveness” of the metrics three members of the research team who had not been responsible for the evaluation of the emergency plans reviewed two plans from each country in order to compare their scores with those obtained by the original reviewer. The results of this exercise are briefly detailed in the following section. The overall results are provided in Appendix D.

The average scores of the original evaluation and the second review do not differ greatly, (a maximum of 0.2 points was found between the average scores), although a shift from one category to another was noted for two of the six reviewed plans. For each plan that was reviewed approximately one third of the metrics were scored differently to the original evaluation.

4.5.1 Overview and conclusions on emergency planning in England and Wales, France and the Netherlands

For each country an evaluation of emergency plans was performed. This section gives an overview of the results and provides a comparison between the countries. An evaluation was made of the quality of the plans using the metrics developed within the project. An overview was gained of the level of detail at which the metrics were addressed within the plans. Table 4.8 shows the results on the scoring of the plans.

Table 4.8 The overall results of the scoring of the emergency plans per country

	England and Wales	France	The Netherlands
Average score of plans	1.9	1.9	1.7
Average plan score category	Average	Average	Room for improvement
Range of scores	1.3 to 2.3	1.1 to 2.4	1.2 to 2.3

Both the average score of the plans as well as the range of scores were similar between the three countries. It is important to note that many plans reviewed were under development or a draft version. The plans score an average or close to average, but could be improved on several points.

Figure 4.5 shows that there is a relationship between the total length of emergency plans, including appendices, and the mean metric score for England and Wales and to a lesser degree the Netherlands. The longest plan reviewed in England and Wales was used in November 2009 in an extreme flood event and received very positive feedback from end users. This may indicate that “ease of navigation” of the plan is more important than plan length. In France there appears to be no correlation between the metric score and the plan length.

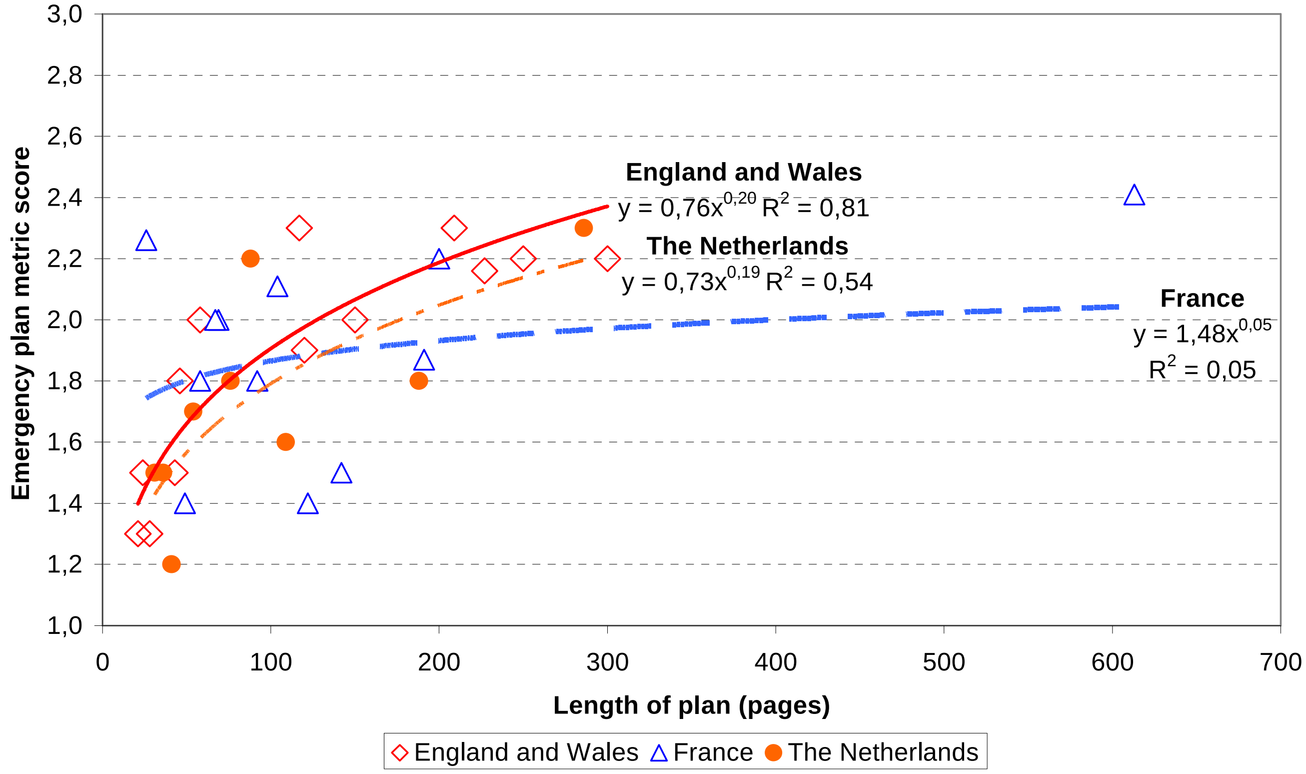


Figure 4.5 **Correlation between length of emergency plan and metric scores for England and Wales, France and the Netherlands**

An overview of the results per metric group is given in Table 4.9. A comparison between the average metric scores for each country is illustrated in Figure 4.6.

Metrics related to organisational aspects of the plan such as: plan activation; roles and responsibilities; communication with other agencies; and target audience and updating scored well in all three countries. The assumptions made by the plan do not appear to be well defined in all three countries. Details of previous floods although covered reasonably well in England and Wales and France are not covered well in the Netherlands; this may be as a result of there have been no major flood events in the Netherlands since 1953.

Metrics related to the possible impacts of floods on receptors such as businesses; critical infrastructure; people; vulnerable people and NaTechs all score well below average in all three countries as well as the metrics concerned with evacuation aspects. The metric for the relationship between complementary plans in England and Wales scored “above average”; however, in France and the Netherlands this metric scored “below average” indicating that there may be a “disconnect” between different complementary plans and that if other plans are referenced there is often not a detailed link provided to them

The metrics provides a measure for quantifying plans making it possible to measure and compare plans. The method in which the metrics are applied is flexible as the metrics themselves can be detailed, metrics can be added or omitted depending on the requirements one wishes to apply for evaluation.

Table 4.9 Overview of results for each metric group in England and Wales, France and the Netherlands

Score category	England and Wales	France	The Netherlands
Maximum metric score	Above average	Good (one metric)	Good (one metric)
Range of metric scores	1.31 to 2.46	1.44 to 2.56	1.08 to 2.58
Metric scores with average and higher scores	Objectives, assumptions and target audience Organization and responsibility Flood hazard	Organization and responsibility Communication	Objectives, assumptions and target audience Communication
Metric scores that are "average", or where a large spread of scores occurred	Communication	Flood hazard Objectives, assumptions and target audience Evacuation	Flood hazard Organization and responsibility
Metrics scores with 'Room for improvement' or lower	Flood risk to receptors Evacuation	Flood risk to receptors	Flood risk to receptors Evacuation

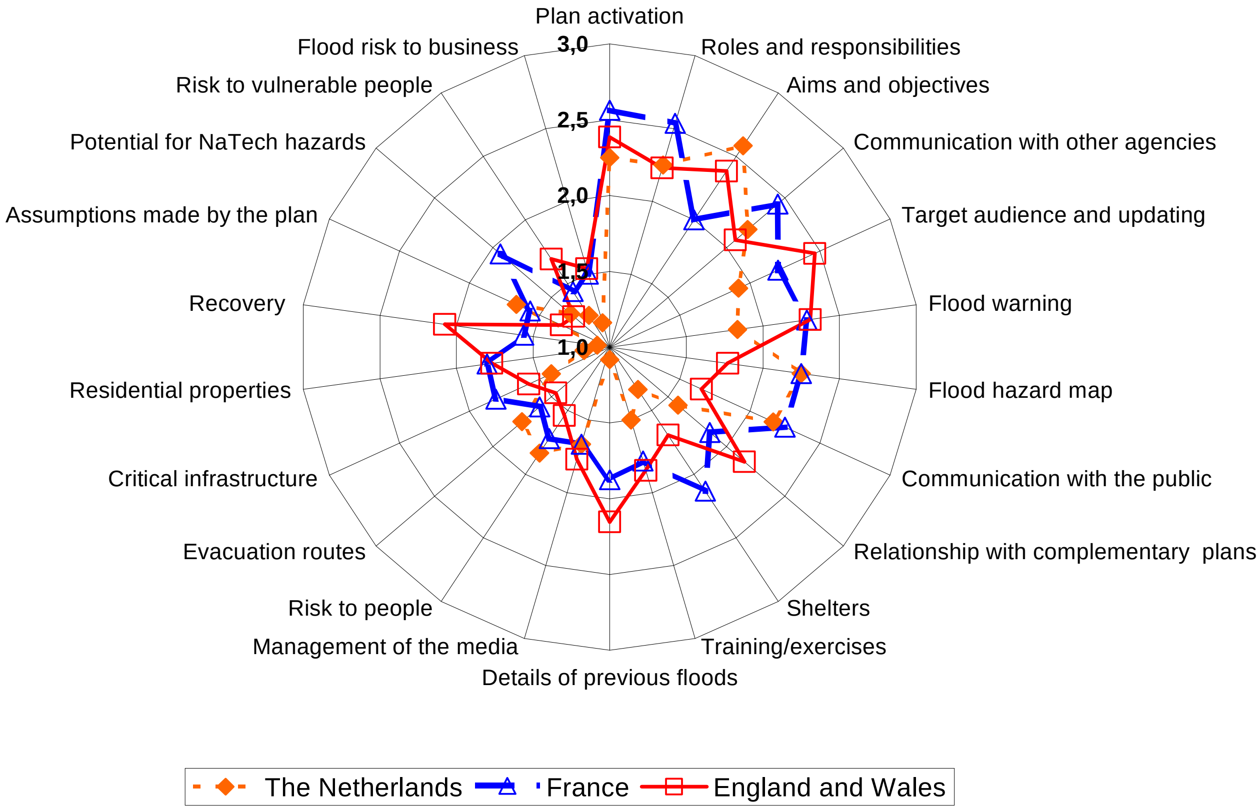


Figure 4.6 Comparison between mean metric scores for emergency plans in England and Wales, France and the Netherlands

5 Engagement of stakeholders on emergency plan requirements

5.1 Introduction

One of the goals of the research was to provide insight into which elements should be addressed in an emergency plan including the level of detail. Through an extensive online survey in England and Wales, France and the Netherlands, disseminated among stakeholders, the views of the actual planners were gathered. This chapter summarizes the details of the research and results.

In January 2010 an online survey was sent to stakeholders in England and Wales, France and the Netherlands. The questions focused on the requirement for information in the plan development stage, the usefulness and required level of detail. In addition the responders were asked which criteria make a plan effective. The results on effectiveness are discussed in chapter 6.

5.1.1 England and Wales

In England and Wales the survey was disseminated via a number of routes including emails to all the Local Resilience Forums, a link to the survey in an emergency management bulletin distributed by the Emergency Management Society and also via the Environment Agency who sent the survey to contacts they had in Local Resilience Forums. A copy of the survey that was sent out to emergency planners and responders in England and Wales is included in Appendix E.

A total of 95 people undertook the survey of these 82 people actively engaged in preparing Multi-Agency Flood Plans, 12 did not and one did not know. The breakdown of the organisations who responded to the survey is given in Table 5.1.

Table 5.1 Breakdown by organisation response to the England and Wales survey

Type of organisation	Percentage of responses
Emergency services (e.g. Fire and Rescue Services, Police Force)	21.2 %
Environment Agency	2.4 %
Health (e.g. Ambulance Service, NHS Trust)	8.2 %
Health and Safety Executive	0.0 %
Local Authority	51.8 %
Transport (e.g. Highways Agency, Network Rail)	4.7 %
Utility (e.g. communications, electricity, gas, water)	4.7 %
Voluntary Organisation	0.0 %
Other	7.1 %

The responders to the survey were asked which Environment Agency Region their MAFP fell under; the results of this are shown in Table 5.2. The Environment Agency regions are shown in Figure 5.1.

Figure 5.1 Environment Agency regions

Table 5.2 Response to the question which Environment Agency Region does your plan fall under

Environment Agency Region	Percentage of responses
Anglian Region	8.3%
Midlands Region	10.7%
North East Region	11.9%
North West Region	32.1%
Southern Region	13.1%
South West Region	11.9%
Thames Region	8.3%
Welsh Region	1.2%
Don't know	2.4%

5.1.2 France

A link to the survey was sent to some 250 people and organisations throughout France involved in the production of emergency plans. The French survey is given in Appendix F. A total of 77 people completed the survey. The target audience for the survey comprised:

- The emergency planner's service: SDIS "Service departmental d'Incendie et de Secours" (department service of firemen)

- The prefecture: head of state service in each department : SIDPC (Service Interministériel de Défense et de Protection Civiles).

The geographical distribution of the responses to the French survey is shown in Figure 5.2. Responses were numerous in large river basins such as Loire basin and Seine river basin where many studies have shown the importance of flood risk. Many responses also came from the southern France region which have been hit by a number of flash floods in the past decade. In those regions, the fact that the GESTER Laboratory at the University of Montepellier III is known by stakeholders probably increased the response rate.

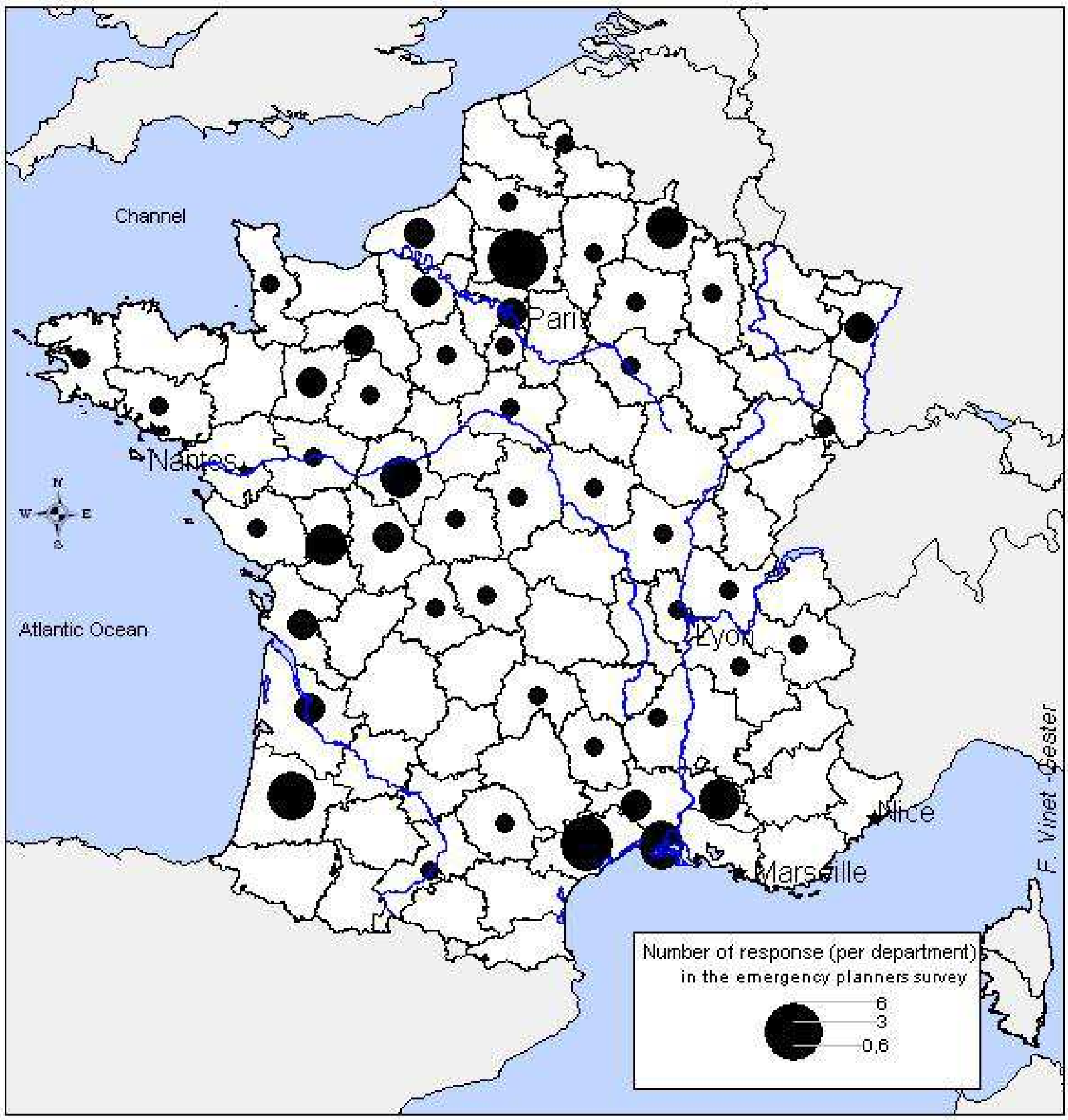


Figure 5.2 Distribution of the responses to the emergency managers survey in France

5.1.3 *The Netherlands*

In the Netherlands 45 stakeholders have completed the survey of which 36 people are actively involved in the preparation of emergency plans, 6 were not and 3 did not know. The breakdown of the type of plans people are working on is given in Table 5.3.

Table 5.3 Breakdown by organisation response to the survey (The Netherlands)

Type of plan	Percentage of responses
Municipal	0.0%
Safety Region	44.7%
National	13.2%
Not applicable	42.1%

5.2 Types of floods that are planned for in England and Wales, France and the Netherlands

The responders were asked which type of flood they plan for. This question was included to see if there is an emphasis on certain types of flood risks. The types of flood risks the responders could choose from corresponded to the types of floods which can be encountered within the different countries. As an example, flash floods are highly unlikely in the Netherlands. Table 5.4 details the types of floods that the responders of the floods deal with.

Table 5.4 Percentage of responders who plan for a particular type of flood

Type of floods	England and Wales:	France:	The Netherlands
Fluvial floods	96.3%	89.7%	60.5 % (Large rivers)
Surface water flooding	90.2%	Not included as an option	Not included as an option
Flooding related to reservoir incidents	59.8%	54.0%	Not included as an option
Flash floods	54.9%	49.4%	Not included as an option
Urban drainage floods	45.1%	46.0%	Not included as an option
Coastal floods	42.7%	39.1%	74.4 %
Groundwater flooding	39.0%	25.3%	Not included as an option
Regional waters (smaller rivers and brooks, canals and polder drainage systems)	Not included as an option	Not included as an option	67.4 %
Other types of floods	11.0%	12.6%	Not included as an option

In England and Wales and France the majority of the responders plan for fluvial floods. For the Netherlands it is seen that most planning is done for coastal flooding. Many of the responders in France and England and Wales also have an involvement in floods related to reservoir incidents, as well as floods related to urban drainage. Of the “other” types of floods that were stated to be planned for, these included flooding from canals and from burst water mains. In the Netherlands emphasis is also given to planning for floods from regional waters (i.e. small brooks and polder drainage).

5.3 Information useful to the formulation of an emergency plan

5.3.1 *Usefulness of information*

As part of the survey the responders where questioned as to the "usefulness" of ten pieces of information in helping them formulate emergency plans for floods. They were asked to "score" the usefulness of the information from 1 to 5, with 1 = "not very useful" and 5 = "very useful". There was also a "Don't know option". The full results of the survey are given in Appendices G, H and I.

Table 5.5 provides a summary of the mean survey scores of the usefulness of information in the formulation of emergency management plans in England and Wales and in France.

Table 5.5 Mean survey scores for the usefulness of information, if it were available, for emergency management plans in England and Wales and France

Information type	England and Wales	France
Potential damage to critical infrastructure	4.60	4.24
The accessibility of inundated roads to emergency services and other vehicles for different flood scenarios	4.53	4.75
The inter-dependencies between at risk critical infrastructure	4.44	3.71
Other hazards triggered as the result of flooding	4.33	4.21
Optimal evacuation routes from the inundated area	4.28	3.75
The time to evacuate people from areas at risk of flooding	4.16	4.18
How improvements in the dissemination of flood warnings could reduce the risk to people	4.06	3.59
Optimum location of shelters and rest areas	3.93	3.83
Probability of buildings collapsing during a flood	3.77	3.42
Potential injuries and loss of life for a range of flood scenarios	3.55	3.77

Note: The Dutch responders were given the options 'not useful' or 'useful' and results for the Netherlands are therefore not included in this table

It is interesting to note that in both England and Wales and France, the top two most useful pieces of information were found to be accessibility of inundated roads and the impacts of floods on critical infrastructure. In France 83% of responders said that it would be "very useful" to get more information about the accessibility of roads to emergency services and other vehicles, (another 12% stated this information would be "useful"). In England and Wales 76% marked information on 'Potential damage to critical infrastructure' to be "very useful". The second and third most popular answer in France regarding usefulness of information related to impacts on critical infrastructure and NaTechs. The lowest ranked pieces of information were for 'Probability of buildings collapsing during a flood' and 'Potential injuries and loss of life for a range of flood scenarios'.

Some 89% of the responders of the English and Welsh survey and 90% of the Dutch responders said that if they had all the above information available to them that it would be useful in formulating their MAFPs. For France only 50% of the responders answered this question positively.

Figure 5.3 shows the normalised metric scores for five metrics compared with the normalised usefulness of the information as perceived by the stakeholders who answered the survey. The normalisation used was:

$$x_{norm} = (x_i - Min)/(Max - Min)$$

Where x_i is the individual metric or usefulness score, Min and Max are the absolute minimum and maximum values in each range (1 and 3 for metric scores, 1 and 5 for usefulness scores). This gives a normalised value (x_{norm}) that ranges between 0 and 1.

The perceived "usefulness" of information on: loss of life; damage to critical infrastructure; other hazards resulting from floods; evacuation routes; and shelters is similar in both England and Wales and France. The mean metric scores shown in Figure 5.3 for the two countries are relatively low indicating that there is a discrepancy between what the stakeholders perceive to be useful and the information that is actually provided in emergency plans.

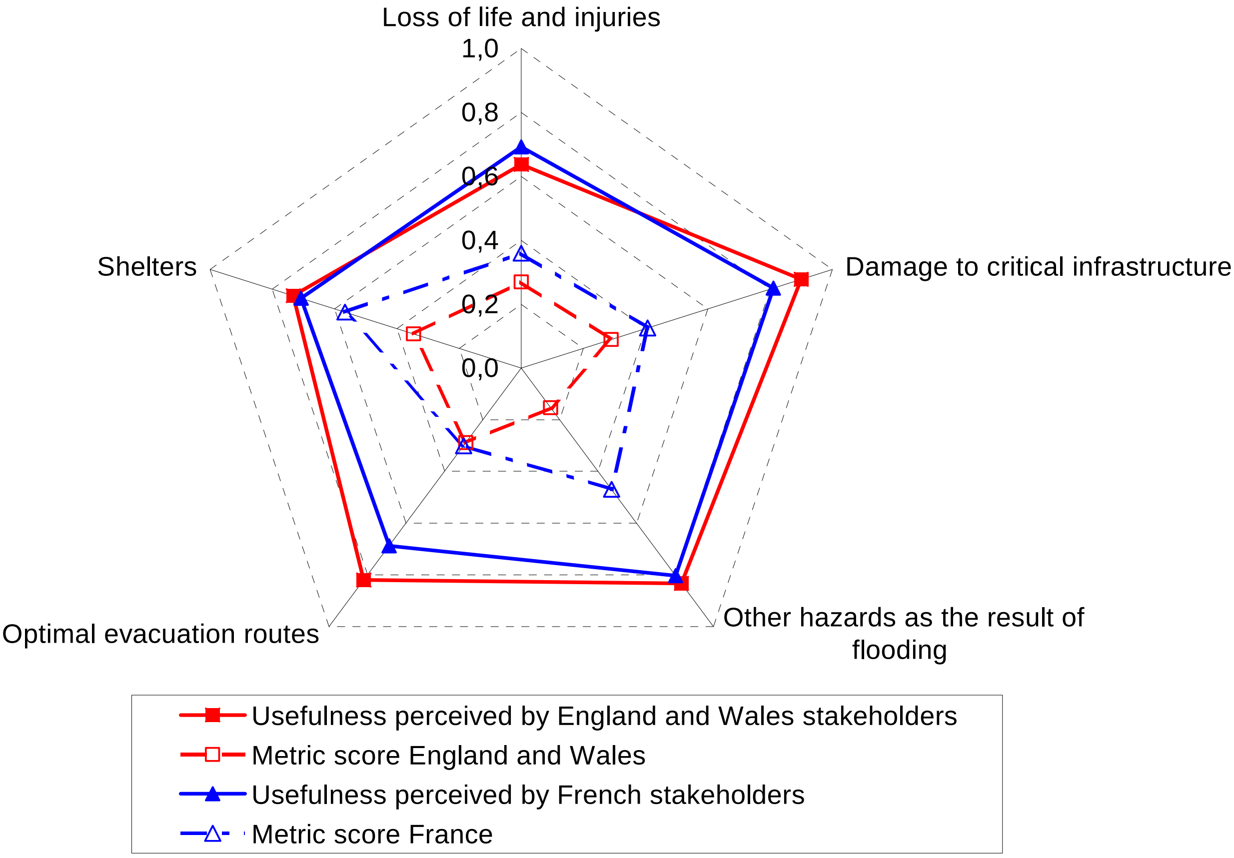


Figure 5.3 Comparison of the normalised scores for the usefulness of information as perceived by the stakeholders and the metric scores for England and Wales and France

5.3.2 Additional required information

The responders were asked if there was any other information related to the impacts of flooding in their area, either not currently available or listed above, that they would like to have available to assist them in formulating emergency plans. The results are described for each country below. The full list of comments is provided in Appendices G, H and I.

England and Wales
The responses to this question can be broadly grouped into the following categories:

- Flood hazard maps;
- Critical infrastructure;
- Evacuation and transport;
- Trigger and forecast levels;
- Flood warnings;
- Other comments.

One responder made the pertinent comment that "*As with all these things, there is a balance to be struck between having enough information to plan efficiently and having so much information that the planner gets flooded.*"

It is interesting to note that there were several comments relating to flood mapping indicating the need for flood depth, velocity and/or a combination of these two parameters to be included on the flood map. Many responders pointed to the need for more information not just on the location of critical infrastructure but also on the consequences relating to the failure of certain pieces of critical infrastructure. There were also comments regarding the difficulty of obtaining information on critical infrastructure although the responders did not specify which types of critical infrastructure.

Responders also commented that the information on evacuation times for reservoir failure scenarios and vulnerable people would be useful. Several comments were made about the need for information on the probability of road inundation and other transport links.

One responder commented on the need for the availability of forecast river levels on the internet and several people commented on the need for clarification of trigger levels for flooding of areas. The comments related to flood warning mainly related to possible changes in the system of warning in England and Wales which is still in the process of being decided.

Of the other comments these mainly related to information on surface water flooding that would be of use although one responder rather worrying stated "*The majority of the information in Question 5 I don't currently have.*"

France
In France 37 people responded to the survey regarding what other information they would need to formulate or improve emergency plans. The answers can be classified as follows:

- Flood hazards data and data required to map flooding (e.g. topographical data);
- Availability of data and tools to assess impacts;
- Adaptability of resources to the crisis;
- Assessment of potential failure in the rescue organisation and the potential failure of the other actors involved in emergency management;
- The need for information linked to the specific features of a region.

The first requirement concerns the evaluation and the mapping of flood hazard. In France there is still room for improvement in the tools, data and methods to assess flood hazard. For example one responder stated that there is a need for *"a tool to correlate water levels and inundated zone"* summarises this demand. Another recurrent need was flood warning systems for ungauged catchments.

The emergency managers also asked for information concerning the impacts of floods on:

- Networks (e.g. roads, electricity or drinking water supply system)
- Sectors that are not inundated but isolated by the floodwater
- The capacity of the rescue organisation

Sometimes tools and data required by the responders are already available. The survey indicated that many responders do not have a complete knowledge of tools available. In some cases information is not used because of the cost (e.g. topographic data and databases of assets such as buildings).

One way emergency planning could be improved in France is to share and standardise GIS information. It is important that services in charge of emergency planning use compatible tools and data. One important constraint is the lack of accurate information on assets at risk. A responder to the survey stated that they would like to be able "*to download all the layers of PPR (Predictable Risk Prevention Plans) in an electronic format to allow them to be imported into our GIS*". The paradox is that PPR data are supposed to be freely available and full accessible.

Emergency planners are also preoccupied with the internal resources of their own organisation in case of crisis. A responder says that "*An assessment of impacts of floods on emergency actors (health service for example) would be necessary in order to evaluate the capacity of emergency and rescue services to fulfil unexpected task*". Another responder stated that "*The failure of other actors or lack of resources can provide more work to emergency services. In the same way, a flood can make populations vulnerable and requires unexpected rescue actions (e.g. transportation of doctors in the flooded area)"*.

Many responses concerned demands that were very specific to their particular area, for example how can new tools and/or research programmes can respond to specific demands such as role of debris flows and railways lines blocking flow routes. An international cooperation in the sharing of tools and knowledge can provide some responses to those specific needs. The full list of comments is provided in Appendix I

The Netherlands
The Dutch responders listed the following additional groups of information:

- Technical aspects such as strength of flood defences, uncertainty in flood forecasting results;
- Relation between Safety Region and Regional – National plans;
- In relation to casualties: Effect of public accessible information on the behaviour of the public, number of inhabitants, determination of shelters;
- Critical infrastructure (such as energy and drinking water providers) and an overview of usable roads;
- Environmental effects.

When comparing these results to the results from the review of the emergency plans, it can be seen that the first two types of information, technical aspects and relations between the different organisations, are often part of the plans already. The other information types are seen to be of a lower standard in many plans.

5.3.3 Appropriate level of detail for information and data

The responders were asked to "score" the level of detail they felt there should be for a variety of subjects in an emergency management plan. The level of detail of the information was scored from 1 to 5, with 1 =

"not detailed in the plan" and 5 = "very detailed". There was also a "Don't know option". The full results of the survey are given in Appendices G, H, I. Table 5.6 provides details of the mean survey scores of the detail of information that should be in emergency plans.

Table 5.6 Mean survey scores for the level of detail of information and data required for emergency management plans in England and Wales, France and the Netherlands

Information type	England and Wales	France	Netherlands
Impacts of floods on critical infrastructure	4.49	4.16	4.13
Flood map showing flood extent	4.41	4.52	4.37
Flood warning lead times	4.13	3.96	4.33
Flood map showing depths, velocities and flow routes	4.08	4.27	4.25
Evacuation routes and times	4.04	3.78	4.30
Flood risk to properties	3.97	3.36	
Shelters, rest areas and safe havens	3.96	4.02	3.81
Flood risk to people in terms of potential injuries and loss of life	3.88	3.32	
Availability of the appropriate resources	3.81	4.03	3.34
Potential for other hazards that may occur because of flooding	3.71	3.63	3.74
Implementation of measures (e.g. sand bags, temporary defences)	3.57	3.27	3.59

For specific pieces of information, differences are seen between the three countries, e.g. availability of resources scores high in France, intermediate in the Netherland and low in England and Wales. On the other hand it is seen that England and the Netherlands have similar items scoring the five highest scores. For France these include the first three items as well as the sixth item.

England and Wales

It is interesting to note that in terms of the level of detail of information of the pieces of information listed above from the review of the Multi Agency Flood Plans (MAFPs) using the developed metrics most of these items fell into the category of either "room for improvement" or "considerable room for improvement". This would seem to suggest that apart from flood warning times there is not enough "relevant" information available to emergency planners to help them with the formulation of MAFPs.

With regards to critical infrastructure that was placed at the top of the list in terms of the level of detail required one responder stated that:

"*There is great reluctance from utility companies to share data on assets and their vulnerability to flooding, partially because they do not have the information on their risk ('well it depends how much rain falls' etc), but mainly because they just don't see what the Local Resilience Forum would do with the information. They are concerned that stating a site is at risk will either result in the gold/silver command taking unilateral action without consulting them, or alternatively will put pressure on them to take action to reduce the risk before it floods. Either way, the benefits have yet to be fully explained, and thus the key infrastructure remains a struggle to obtain*."

France

In terms of level of detail required flood hazard maps scored highly and many responders wanted flood maps that show information about depth, velocities and flow routes. Impacts of flooding on critical infrastructure featured heavily. However, similar to England and Wales the impacts of flooding of people in terms of loss of life did not feature highly. This is interesting as the comments of the responders indicate that emergency managers are focused on the safety of human life and the protection of public infrastructures and services rather than in the defence of properties and goods.

The Netherlands
In the Netherlands evacuation routes and times were seen as the most important piece of information. In January 1995 some 250,000 people had to be evacuated in the Netherlands as a result of high water levels on the River Rhine and River Meuse. As a result evacuation may be higher up the emergency planning agenda in the Netherlands than in France or England and Wales.

5.4 Communication, responsibilities and assumptions

The responders were asked to "score" the level of detail for issues relating to communication, responsibilities and assumptions they felt there should be for a variety of subjects in an emergency plan. The level of detail of the information was scored from 1 to 5, with 1 = "not detailed in the plan" and 5 = "very detailed". There was also a "Don't know option".

Table 5.7 provides details of the scoring by responders of the level of detail of information that should be in emergency plans of various items related to communication, responsibilities and assumptions.

Table 5.7 Mean survey scores for the level of detail of communication, responsibilities and assumptions required for emergency management plans in England and Wales, France and the Netherlands

Information type	England and Wales	France	Netherlands
Plan activation (e.g. trigger levels etc)	4.52	4.14	4.35
Communication with other agencies	4.48	3.64	4.32
Communication with the public	4.39	3.95	3.95
Communication with the media	4.28	3.39	3.99
Relationship with complementary emergency management plans	4.05	3.65	3.58
Details of recovery	3.85	3.14	3.06
Aims, objectives and assumptions of plan	3.72	3.50	3.35
Training and exercises	3.56	3.46	3.27
Target audience of plan	3.53	4.02	3.70
Details of modifications to and updating of the plan	3.44	3.02	3.35

The item plan activation has the highest required level of detail for the three countries. For England and Wales and the Netherlands it is seen that a higher level of detail is wanted for the items on communication (second to fourth items). Recovery and updating of the plan do not need to be specified in a high detail level.

England and Wales:
It is interesting to note that in the review of the MAFPs, issues related to plan activation, communication with other agencies and the media, relationship with complementary plans all scored relatively well. It would appear that issues related to communication and responsibilities are currently relatively well covered by MAFP. It should be noted that the assumptions made by MAFPs were often not explicitly stated.

France
Information regarding communication can be classified in two groups. Information and communication required before the crisis such as target audience, plan activation and communication to public scored "above average". Items related to the post disaster phase are often neglected.

The Netherlands
Issues relating to 'Training and exercises' and 'Relationship with complementary emergency plans' were found from the review of the plan to rate as "Room for improvement". It was seen that for these issues a

low detail was provided in the plans. The lowest ranked item 'Recovery' scored a "Considerable room for improvement" in the review of the emergency plans.

5.5 Comparison of plan metric scores and the level of detail required by stakeholders

Figure 5.4 shows the normalised metric scores for seven metrics compared with the normalised level of detail required in a plan as perceived by the stakeholders who answered the survey. The perceived "level of detail" of information on: flood risk to people; flood risk to property; critical infrastructure; evacuation; NaTechs; shelters; and flood maps is similar in all three countries. The plan mean metric scores shown in Figure 5.4 for the three countries are relatively low indicating that there is a discrepancy between the stakeholders required level of detail and the information that is actually provided in emergency plans.

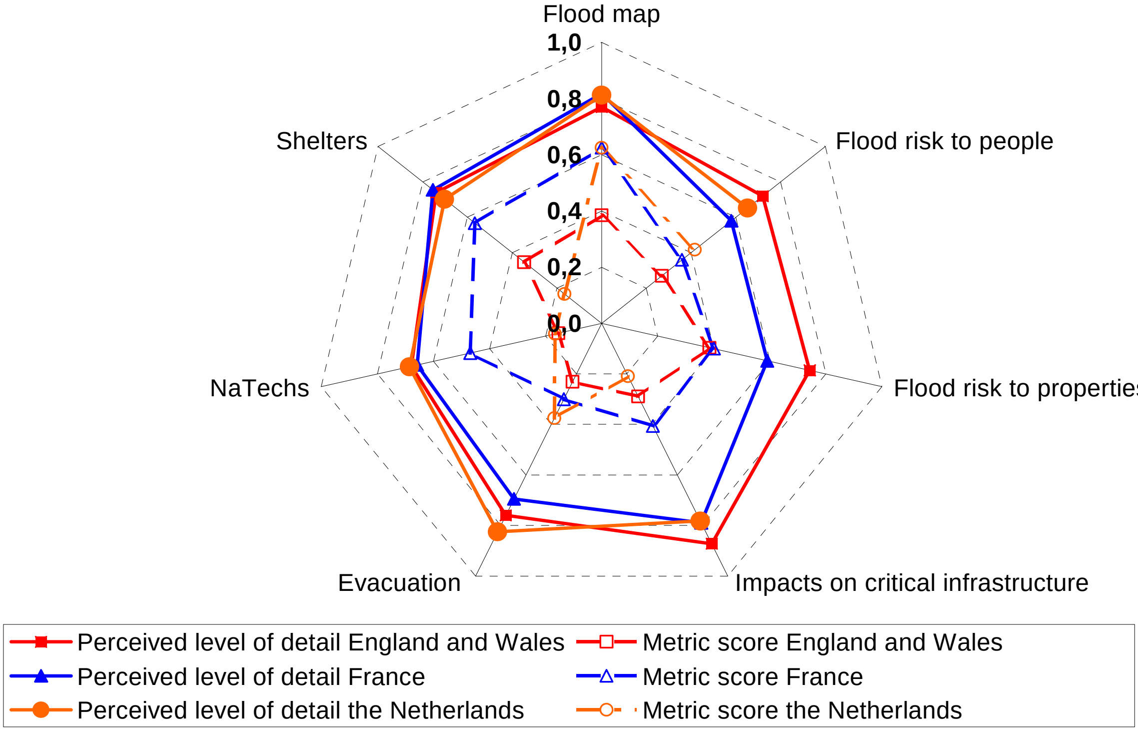


Figure 5.4 Comparison of the normalised scores related to receptors for the required detail of information as perceived by the stakeholders and the metric scores for England and Wales, France and the Netherlands

Figure 5.5 shows the normalised metric scores for seven further metrics compared with the normalised level of detail required in a plan as perceived by the stakeholders who answered the survey. The perceived "level of detail" of information on issues related to communication and organisational aspects of the plans are similar in all three countries. The plan mean metric scores shown in Figure 5.5 for the three countries are much closer to the perceived level of detail required by the stakeholders than the metrics shown in Figure 5.4 related to risk to the receptors. There are some exceptions including communication with the media; details of recovery in France and the Netherlands. However, in general these aspects are covered in more detail.

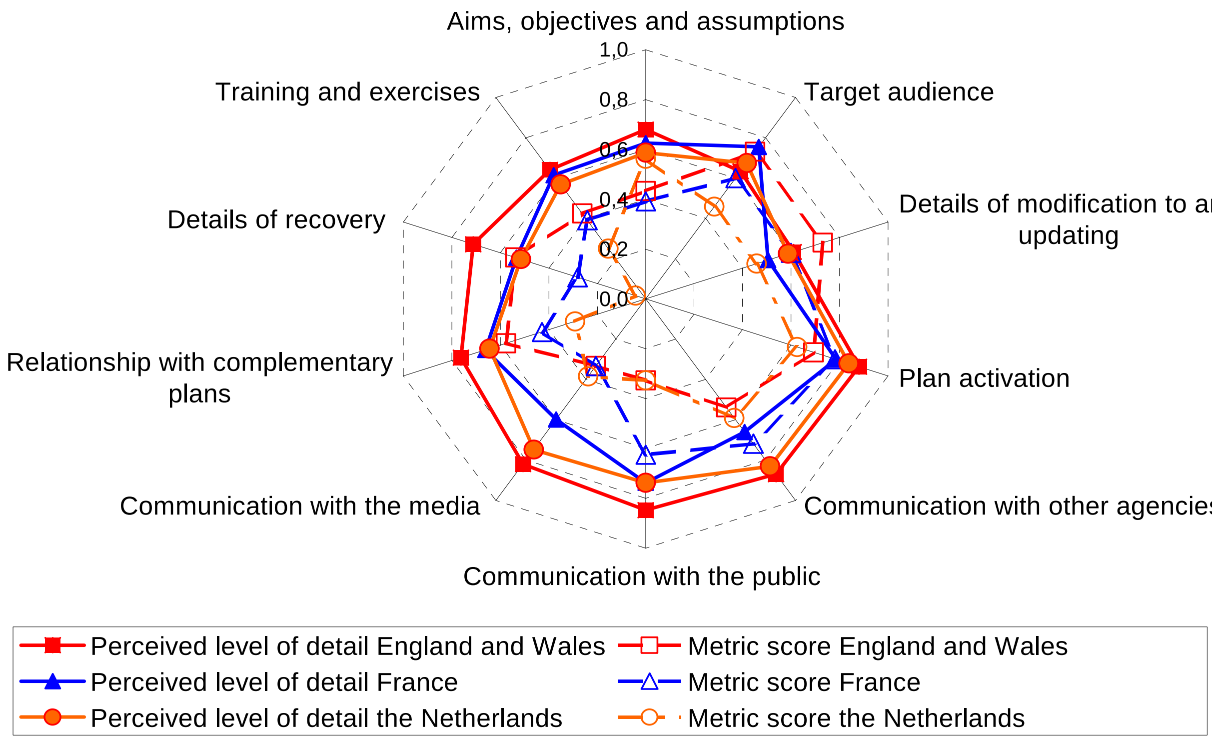


Figure 5.5 **Comparison of the normalised scores related to communication and organisation for the required detail of information as perceived by the stakeholders and the metric scores for England and Wales, France and the Netherlands**

6 Effectiveness of emergency plans for floods according to stakeholders

6.1 Survey results

As part of the survey the responders were asked to briefly list up to five criteria that they believed make an emergency management plan effective. The full list of answers to this question is given in Appendices G, H and I. A summary for each country is given below.

6.1.1 England and Wales

The criteria given by the responders can be grouped under the following headings in terms of the number of comments received:

1. Roles and responsibilities
2. Triggers levels
3. Flood mapping
4. Clarity and brevity of the plan
5. Relationship of the MAFP with other plans
6. Partnership approach in the production of the plans
7. Communication
8. Critical infrastructure
9. Training in the use of the plan
10. Other comments

These are discussed briefly below.

1. Roles and responsibilities
Some 24 comments were made stating that for an MAFP to be effective it had to have clear definition of agency roles and responsibilities and links to related plans. The "actions, roles and responsibilities" metric was found to be one of the higher scoring metrics. This would indicate that this is currently relatively well covered by MAFPs. Most of the MAFPs reviewed had details of the roles and responsibilities in a flood emergency. Many MAFPs had separate appendices for each actor in an emergency detailing their roles at different points in the flood. One responder summed up that an effective MAFP needed to have "*Roles and responsibilities clearly spelt out and agreed (with no assumptions made by any organisation)*".

2. Triggers or trigger levels
The second most popular answer in terms of what makes an MAFP effective was related to trigger levels. A trigger level can be defined as "an action causing the automatic invocation of a procedure". Many responders stated that for an MAFP to be effective clear triggers were needed to invoke actions and responses. There seemed to be a broad consensus that there needs to be clear definitions and guidance on how the MAFP is activated. In terms of the review carried out by the MAFPs the plan activation metric was found to be the third highest scoring metric indicating that the MAFPs that were reviewed covered this important aspect of emergency planning.

3. Flood mapping

There were of the order of 20 comments that related the effectiveness of an MAFP to provide flood maps. Many responders stated that the maps needed to have the following qualities:

- Up to date
- Be detailed
- Be available to all the agencies involved.

Feedback from the use of the MAFP during the recent floods in Cumbria indicated that flood mapping could be improved by:

- The inclusion of larger maps or maps showing more detail;
- The addition of maps of some areas highlighted as "hotspots" or which have a high flood risk and flooding history;
- The inclusion of the flood maps on an integrated GIS system.

The flood hazard mapping metric for the MAFPs reviewed in England and Wales had an average rating of "room for improvement". Many responders stated that flood maps showing maximum velocities and depths would be useful. These should now be available for the areas covered by many Local Resilience Forums as in more densely populated parts of the country the Environment Agency has often carried out two dimensional hydraulic modelling that can produce such maps.

4. Clarity and brevity of the plan

Many responders to the survey stated that for an MAFP to be effective it needed to have clear unambiguous wording and not be too long. One responder stated: "*A simple plan without great detail, signposting where further information is rather than including it in the plan to make it a bulky, dust gathering, document*." However, it is interesting to note that the MAFP for Cumbria that stretches to 300 pages was found to be "*compact and information in it was relatively easy to locate*" following its use in the recent floods in November 2009. It is also a plan that rated as being "above average" when the metrics were applied to it.

5. Relationship of the MAFP with other plans

For an MAFP to be effective 14 responders to the questionnaire stated that it needs to reference other relevant plans (e.g. evacuation, rest centre, recovery plans). An MAFP should also not duplicate information that appears in other plans. One responder stated "*if we need to wade through many different templates to get a picture of all the places that flood and the consequences, it will be hard to formulate a co-ordinated and prioritised response*." There should also be a difference between emergency flood plan and flood guidance. Sometimes the two appear to be mixed together which one responder stated "*makes a plan unusable in a crisis*". It is interesting to note that of the MAFPs reviewed the metric relating to the relationship of MAFPs with other plans was one of the higher scoring ones.

6. Partnership approach in the production of plans

Many responders to the questionnaire stated that for an MAFP to be relevant then there need to be a partnership approach to the formulation of the plan and that there should be "*engagement through Local Resilience Forums to truly reflect and seek engagement from all stakeholders*" when the plan is being put together.

7. Communication

Around ten responders stated that for a MAFP to be effective there needed to be clear lines of communication detailed within the plan.

8. Critical infrastructure

Recent flooding in England and Wales has highlighted the vulnerability of water, gas, communication and electricity supply infrastructure, collectively known as critical infrastructure. A similar sentiment was expressed by many responders that it is important to identify critical infrastructure within floodplains and to have an understanding of the effect of what would happen if any of this infrastructure becomes inundated.

9. Training in the use of the plan

Nine responders stated that for an MAFP to be effective it needed to be used in a training exercise with the various actors involved and then "lessons learnt" following the training, exercise or a real flood incident needed to be incorporated in the plan.

10. Other comments

There were a range of other disparate comments relating to what makes an MAFP effective. These are summarised in Appendix H.

As part of the survey the responders were also asked if they had any further comments that they may wish to make about tools, methods or guidance that you believe could contribute to improving Multi Agency Flood Plans. These comments are provided in Appendix H.

6.1.2 France

The criteria given by the responders can be grouped under the following headings in terms of the number of comments received:

1. Communication and relationship between the different actors responsible for emergency planning
2. Knowledge of hazards and risks
3. Knowledge of processes and capabilities
4. Simple and adaptable
5. Exercises, updating and feedback
6. Information and communication
7. Assumptions and competencies

1. Communication and relationship between the different actors responsible for emergency planning

The first condition to ensure the effectiveness of an emergency plan is that the plan must be known and effectively shared and disseminated with all the actors. Some 30 responders to the French survey pointed out the necessity to maintain relationships with stakeholders and actors during the management of an emergency to make a plan effective. Responders also felt that the relevant authorities must be involved and informed in the production and the implementation of the plan. The effectiveness of plan could also be ensured by the compatibility of tools and data used by different actors.

2. Knowledge of hazards and risks

Responders indicated that they needed accurate information of the flood hazards and also on the elements at risk. There were a number of responses concerning the knowledge of receptors such as to people, properties and infrastructure at risk from flooding. Mapping and GIS were considered as important elements in making an emergency plan effective. Mention was also made of the need for trigger levels for areas that are not monitored by standard gauge points and flood maps showing the extent of flooding for different gauge levels.

3. Knowledge of processes and capabilities

The knowledge of process of plan activation (trigger levels, alert to people, rescue) is an important issue in the effectiveness. The information and processes must be standardized and known by all the actors. The language used in the plan must be understood by all the stakeholders and actors involved in the plan. It is also important to estimate the resources available to face up the crisis. It is also necessary to assess and to foresee the possibility of a crisis management organisation failure.

4. Simple and adaptable

Some 18 responders wrote the word “simple” as an element to qualify the effectiveness of a plan. Others words come out such as “readable, clear, legibility”. A weighty and complicated plan is not easy to learn for emergency planners and difficult to implement. “*Too much information kills information!*” was written by one responder.

The adaptability of the plan was mentioned by responders. Responders stated that this may be ensured by having several scenarios in order to have a progressive response to the emergency. The emergency plan must not only rely upon one scenario, which is often a scenario based on a rare event. The plan must not be too rigid and must be able to be adapted to unforeseen situations and “domino effect” (e.g. other hazards triggered by floods).

5. Exercises, updating and feedback

Exercises are mentioned to be a condition of the effectiveness of plans. Those exercises and trainings have to associate all the stakeholders and actors and if possible must involve authorities and policy-makers. Three responders estimate that historical information must be addressed in the plan. Feedback analysis for the updating of the plan was also quoted by around ten responders.

6. Information and communication

The communication of internal information was said to be a major factor in the effectiveness of the plan: communication between stakeholders.

7. Assumptions and competencies

For an emergency plan to be effective there needs to be a clear definition of its assumptions and a clear definition of the competencies required from each actor during the emergency.

6.1.3 The Netherlands

In the Netherlands when the stakeholders were consulted on what made an emergency plan effective the following answers were given. These were ranked as follows:

1. Organisation, command, responsibility
2. Information/knowledge
3. Readability and accessibility
4. Training
5. Decision making
6. Other aspects

1. Organisation, command, responsibility

Within the Netherlands, a well defined organisation and responsibility structure was seen to be of great importance. Elements mentioned by stakeholders included communication between parties, a clear command, “upscaling” of responsibilities when an event increases and clear defined roles and responsibilities.

2. Information/knowledge

The availability of information was mentioned by several responders including:

- Information on the flooding characteristics such as inundation (i.e. velocity, water depth, flow velocities), reliable predictions, insight into chain effects, scenarios;
- Information on evacuation and shelters;
- Possible measures;
- Area specific information.

The availability of the information during an event was also mentioned by the responders. In the Netherlands a system and work process has been set up (“Netcentric working”) to improve the availability of information and communication between partners during an event.

3. Readability and accessibility

The accessibility, simplicity, clarity of a plan was mentioned as an important factor. During an event one should be able to read a plan quickly and find important items easily. In addition it was mentioned that a plan should be ‘kept in a logical place’.

4. Training

Training, exercise and education were mentioned several times. This aspect is related to the previous point. The accessible of a plan is improved if more people are familiar with the plan. In addition training results in identifying weaknesses in the plan and process, makes it possible for the different parties to get familiar with each other’s work process and gives an opportunity to get used to software tools used during an event.

5. Decision making

During an event several decisions need to be made. For example when does an event require a higher level of responsibility/administrative level, or the decision to execute a preliminary evacuation. Two responders mentioned these aspects of the criteria and information on which decision making is based.

6. Other aspects

Other aspects mentioned were the date of the plan, communication to the public, the relation with other plans and implementation by the involved organisations.

6.2 A summary of the face-to-face consultations with stakeholders

6.2.1 England and Wales

From the discussions we have had with stakeholders responsible for producing Multi Agency Plans there is often a sense of a “responsibility and knowledge gap” between Local Authority emergency planners and Environment Agency staff. One responder to the survey summed this up by stating that:

“*The overall feeling is that the Environment Agency on a regional and local level could and should take a far stronger role as hands-on facilitators of this work. They have far more experience of producing flood plans and responding to flooding than Local Authorities and this knowledge based on lessons learnt is not being utilised. The support from the Environment Agency is lacking at a local level - as a Local Authority Emergency Planning Unit we cover a number of local authority areas, if we want to use GIS we have to either approach each separate council to produce mapping products resulting in non-standard maps being incorporated into the plan or somehow try and synchronise data from all authorities into an in house GIS which then results in issues around data licensing particularly for populations/number of residences etc. The Environment Agency is far better skilled and resourced to undertake this work.*”

There was a general consensus that in many cases a lot of duplicate information is contained within different emergency plans. Consultation meetings have suggested that a checklist of actions could be useful to include in an emergency plan. This would be used to record that generic actions had been taken. This could be more useful than specifying detailed responses to specific trigger levels, given the other information available in the plans. Some stakeholders also thought that an overview of how all of the organisations involved in the response to a flood emergency fit together would be of use. It was also stated that use of visualisation techniques (e.g. having access to digital and suitably sized paper copy maps) is important during a flood incident.

6.2.2 France

Interviews were held with emergency planners in southern France in the Gard and Herault Départéments. Emergency managers pointed out that there was room for improvement in their own capacity to analyse the ability of the organisation to operate efficiently for a sustained emergency. Emergency planners were also eager to assess the potential failure of internal and external emergency management organisation.

The interviews with emergency planners highlighted the role of practice and experience in the management of a crisis. Many emergency planners improve their knowledge through feedback from previous flood incidents. Emergency planners who recently managed a crisis are more confident in their knowledge of field and emergency situations. The PCS plans cover all emergencies. Unlike many other hazards floods can be forecast several hours or in some cases several days in advance. There is also a perception by responders and planners that floods can be handled by people with a lower degree of "technical competencies" unlike forest fires or technological hazards.

6.2.3 The Netherlands

For the project entitled the "National Evacuation Module (LEM)", interviews have been held with different parties involved in mass evacuation during a flooding event. The results of three questions, focusing on the effectiveness and bottlenecks of evacuation and event management planning, are of interest to the FIM FRAME project:

1. What makes an event plan effective? How does one check if a plan is effective?
2. What are the most important bottlenecks encountered with regards to process?
3. What are the most important bottlenecks encountered with regards to the content of the plans?

The following paragraphs give a summary of the results. Full results for these questions can be found in Appendix J.

Common sense and expertise
A flood and a mass evacuation are situations which very rarely occur in the Netherlands. Flood emergency plans are therefore hardly ever put to the test in real life. Several people therefore responded to the question 'What makes a plan effective' by noting that a plan is developed on expertise and use of common sense. One interviewed said: "*A plan is never completed. It is hard to tell if a plan is good."* Another mentioned: "*The expertise of the plan developers is conclusive.*"

Framework and guidelines
There are no criteria available to judge the effectiveness of a plan. In the Netherlands there is a lack of a framework or guidelines for setting up a plan. On a regional level, it is indicated though that there is a need for guidelines to assist the regions with the development of plans. Currently the 'Ministry of Traffic and Water' are developing a framework for the review of plans which in future could be used for the phase of developing plans as well.

Training and exercise
The need for training in and exercising a plan was emphasised by different interviewees. Training and exercise results in organizations taking ownership of plans and results in identifying shortcomings in the plan and critical paths in the organization. In addition the feasibility and workability of a plan is tested during the exercise. As a requirement for a plan to be effective, one interviewed said "*a plan should be feasible, executable and embedded in the organization*."

Actions, roles and responsibilities
An aspect mentioned as an issue by many of those interviewed was the link between a national and regional level and the cooperation between regions. To be able to effectively deal with a large flood, the coordination between the national and the regional level will need to be improved. The large number of

parties involved which all seem to have an advisory role instead of a command and control role was also mentioned as an issue.

A flood event in the Netherlands could cover a large spatial scale and as a result several people interviewed felt that it is inevitable that certain aspects need to be coordinated on a national level. Examples given were the general coordination and the appointment of refuge locations. These aspects need to be planned for on a national level, but currently it is felt by those interviewed that the current plans are not sufficient to deal with such a large event.

Risk perception and communication, behaviour of the public
Currently there is a lot of attention and research on risk perception and communication. Several of those interviewed mentioned the subject. One person mentioned that "*the behaviour of people during an event should be taken into account when evaluating plans"*, while another said "*the behaviour of the people is the big unknown*." Risk and crisis communication and behaviour of the people nonetheless were seen to be constraints. There is little experience with mass evacuation and both the public and the relief services do not have a realistic image of a mass evacuation.

Elements within a plan
For a plan to be effective the following elements were mentioned as being essential in a plan:

- Clearly defined actions and checklists. Plans should lead to a checklist for policy makers and checklists and action maps for operations;
- It should be clear what a plan is based on and what instruments were used to make a plan;
- Aims, assumptions and starting points are made clear and explained (including error/uncertainty margin);
- Resources (mentioned by several interviewed). From the plan the requirements for number of people and resources can been made;
- When a range of scenarios has been considered.

In addition the following elements were mentioned to be constraints owing to a lack of knowledge or attention given to the subject:

- Care and shelter. How is care and shelter organized on a national level?
- Scenarios. Overview/insight of chosen assumptions on which the plan is based and reason why this choice was made. During an evacuation if it is seen that the situations differs from the assumed situation for the plan, one can choose to change the plan.
- Traffic management. Traffic management is seen as an important issue covering different aspects such as the availability and overview of situation on the roads, the capacity of the exits of an area, capacity and availability of the infrastructure, organization of incoming and outgoing traffic and knowledge on use of public transport during an event.

6.3 Discussion on effectiveness of plans

According to the responders from the three countries a well defined description of the roles, responsibilities and communication between the parties is essential for a plan to be effective. This criterion is followed by criteria on the availability of knowledge and information. The criteria 'clarity, accessibility and 'simpleness' of the plan' were also mentioned in the three countries, as well as training and exercise. The familiarity with a plan is improved if trained. In addition training results in identifying weaknesses in the plan and process. Other specified criteria differ for the three countries.

7 Conclusions

There is often a lack of homogeneity between the emergency plans that have been reviewed. Although to a certain extent this is to be expected given the different nature of the flood risk in the areas covered by the plans that were reviewed. However, the same information for example was often expressed in significantly different levels of detail. For example in England and Wales, two MAFPs did not include flood hazard maps and did not state if these were readily available either in other plans or other forms (e.g. CD ROM or a secure web site). In the Netherlands many of the flood maps included in emergency management plans had details of maximum velocities. There is also a room for improvement in many plans in the production and the use of such maps. What sort of maps can be used to prepare the crisis management? Is GIS really useful and effective during the emergency? Is it easier to use hard copy during an emergency rather than a GIS especially at local level? It is also interseting to note the differences in the availability of the maps in the three countries. An improvement can be made in publishing maps that are easily readable for the target audience.

Many of the plans reviewed had what could be classed as a large amount of generic “cut and paste” text on flooding but had limited text on local or regionally specific issues. It would appear from the research that many of the responders would like more specific information especially with regards to the nature of the flood hazard and the accessibility of roads to emergency services and other vehicles for different flooding scenarios. In many densely populated areas it would be relatively easy to develop such maps for different probabilities of flood events.

In England and Wales there was a distinct correlation between the length of the plan and its “quality”, as measured by the metrics that have been developed by the research. This was also the case, to a lesser extent, in the Netherlands. However, in France there was almost no correlation between the length of an emergency plan and its metric score. It is interesting to note that many of the stakeholders consulted as part of this research stated that in order for a plan to be effective it should be “*concise*” or “*short*”. The MAFP for Cumbria in England that was put into action during severe flooding in November 2009 is some 300 pages in length. This was one of the longest of the plans that was reviewed. However, feedback from the stakeholders who used it during this emergency was that “*the plan was found to be compact and information in it was relatively easy to locate*”.

Figure 7.1 shows a comparison of the metric scores for the three countries for the emergency plans that have been reviewed. Metrics related to organisational aspects of the plan such as: plan activation; roles and responsibilities; communication with other agencies; and target audience and updating scored well in all three countries. The assumptions made by the plan do not appear to be well defined in all three countries.

Details of previous floods although covered reasonably well in England and Wales and France are not covered well in the Netherlands; this may be as a result of there having been no major flood events in the Netherlands since 1953. Although it is interesting to note that the 1953 flood does not seem to be referenced in Dutch plans.

Metrics related to the possible impacts of floods on receptors such as businesses; critical infrastructure; people; vulnerable people and NaTechs all score well below average in all three countries. Overall, the plans for England and Wales showed the greatest differentiation between the scores for ‘organisation and responsibilities’ and for ‘impact on receptors’.

Figure 7.2 shows the normalised metric scores for five metrics compared with the normalised usefulness of the information as perceived by the stakeholders who answered the online survey. The perceived "usefulness" of information on: loss of life; damage to critical infrastructure; other hazards resulting from floods; evacuation routes; and shelters is similar in both England and Wales and France. The mean metric scores shown in Figure 7.2 for the two countries are relatively low indicating that there is a discrepancy between what the stakeholders perceive to be useful and the information that is actually provided in emergency plans.

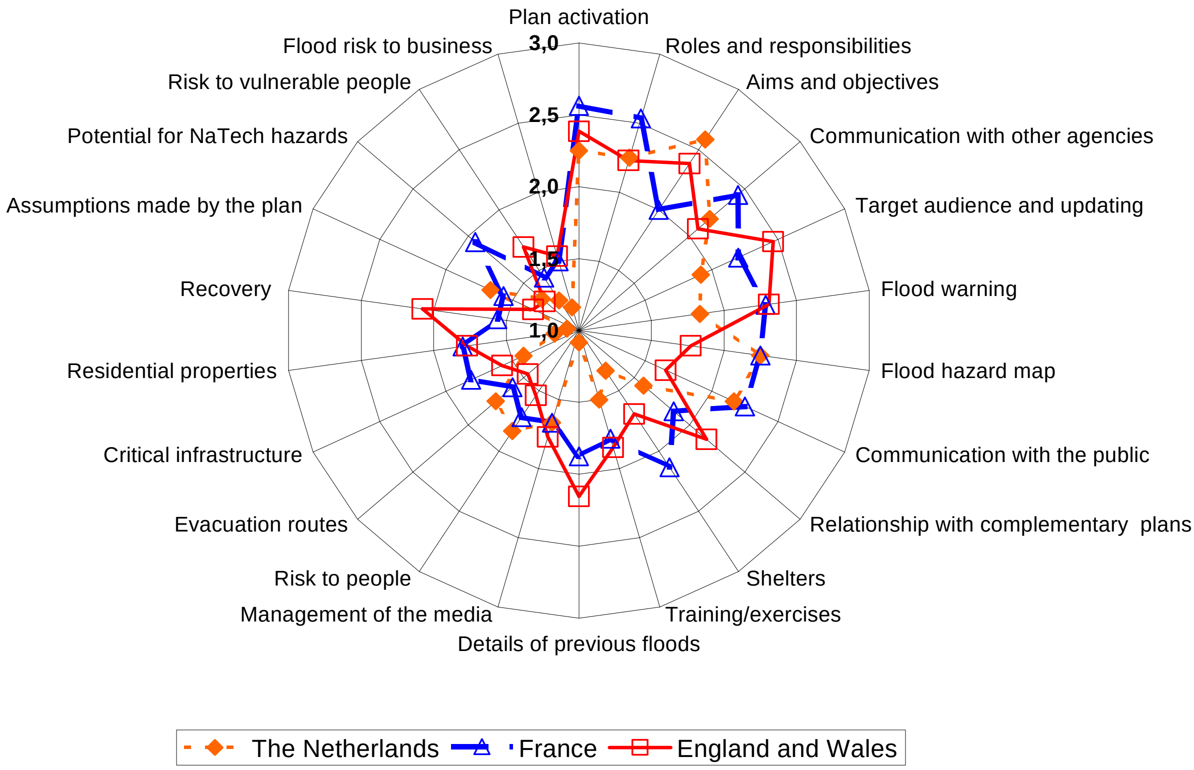


Figure 7.1 **Comparison between mean metric scores for emergency plans in England and Wales, France and the Netherlands'**

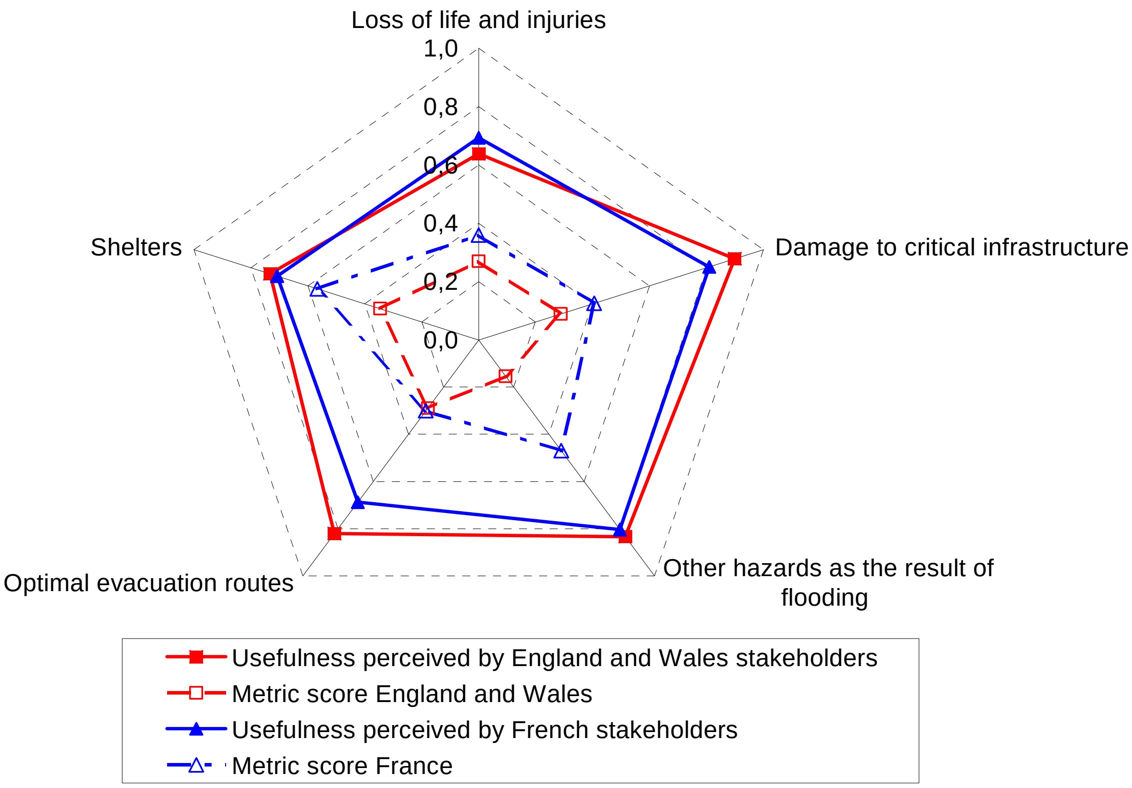


Figure 7.2 Comparison of the normalised scores for the usefulness of information as perceived by the stakeholders and the metric scores for England and Wales and France

Figure 7.3 shows the normalised metric scores for seven metrics compared with the normalised level of detail required in a plan as perceived by the stakeholders who answered the survey. The perceived "level of detail" of information on: flood risk to people; flood risk to property; critical infrastructure; evacuation; NaTechs; shelters; and flood maps is similar in all three countries. Again, the mean metric scores shown in Figure 7.3 for the three countries are low indicating that there is a discrepancy between the stakeholders' perceived level of detail required and the information that is actually provided in emergency plans.

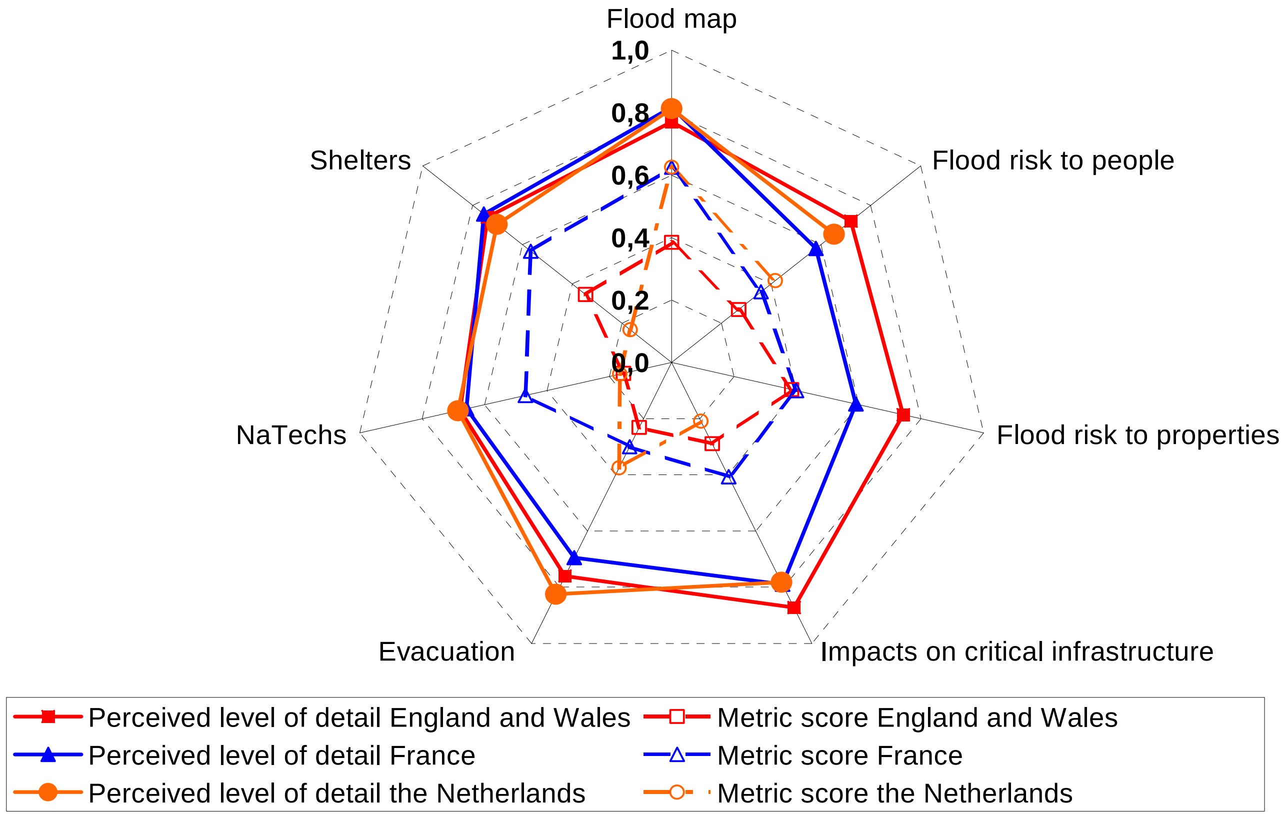


Figure 7.3 Comparison of the normalised scores related to receptors for the required detail of information as perceived by the stakeholders and the metric scores for England and Wales, France and the Netherlands

Figure 7.4 shows the normalised metric scores for seven further metrics compared with the normalised level of detail required in a plan as perceived by the stakeholders who answered the survey. The perceived "level of detail" of information on issues related to communication and organisational aspects of the plans are similar in all three countries. The mean metric scores shown in Figure 7.4 for the three countries are much closer to the perceived level of detail required by the stakeholders than the metrics shown in Figure 7.3 related to risk to the receptors. There are some exceptions including communication with the media; details of recovery in France and the Netherlands. However, in general these aspects are covered in more detail.

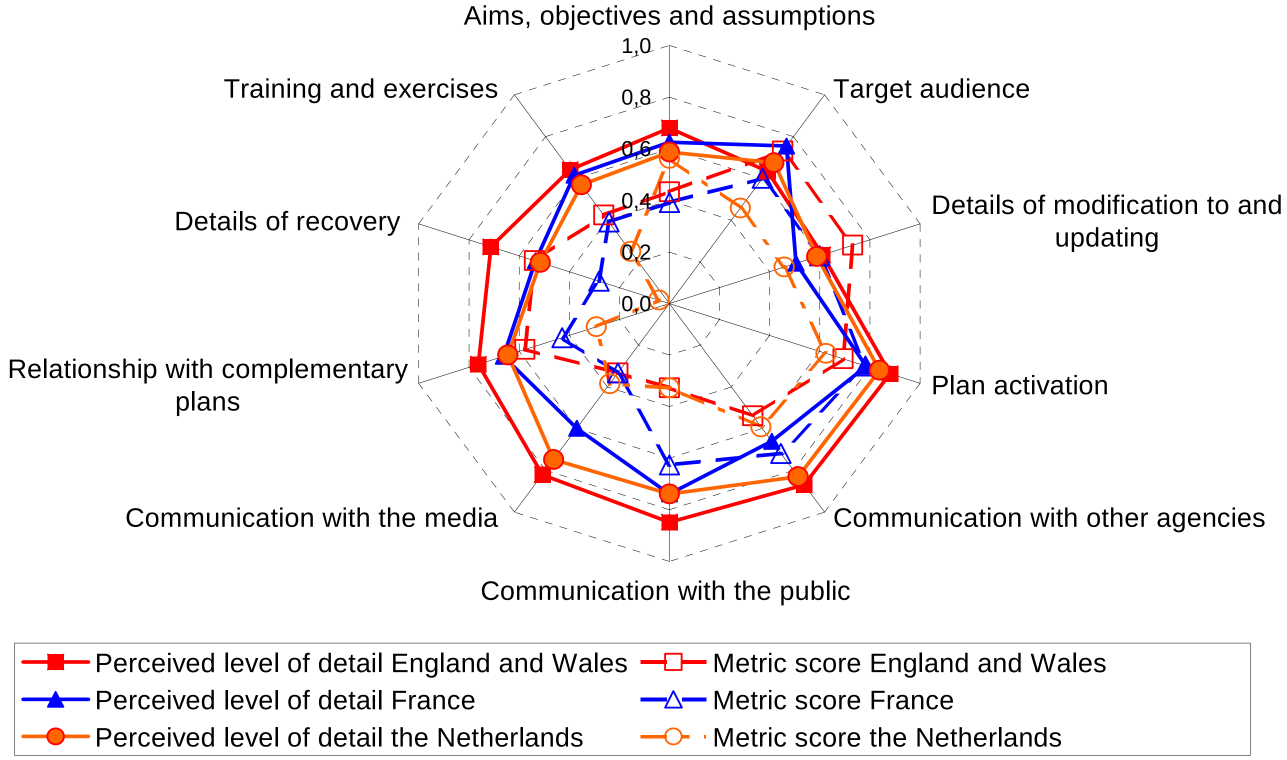


Figure 7.4 **Comparison of the normalised scores related to communication and organisation for the required detail of information as perceived by the stakeholders and the metric scores for England and Wales, France and the Netherlands**

The metrics developed as part of the research have proved to be a useful tool for assessing emergency plans, for identifying strong points and weaknesses, as well as providing a basis for comparison of the plans. There will always be some "subjectiveness" involved when applying the metrics, however, the metrics in the context of this research provide a basis to map the following:

- Where improvements can be made in the plans
- Requirements of the stakeholders
- Use and availability of tools that can be used to improve plans and meet the requirements of emergency planners and responders.

The following conclusions can be made from the research carried out:

(i) Metrics related to implementation of plans and organisation tend to be high in all three countries

In England and Wales, France and the Netherlands metrics such as "plan activation"; "actions, roles and responsibilities", "flood warning" and "target audience and updating"; and "aims and objectives" all score well. In England and Wales many stakeholders who took part in the research stated that it was important to have roles and responsibilities well defined in flood emergency plans for different levels of flooding. The scores of these metrics would indicate that in general emergency planners are covering these subjects well.

(ii) Flood hazard maps

The metrics would appear to indicate that there is a difference in the way that flood hazard is depicted in emergency plans between England and Wales, France and the Netherlands. In France and the Netherlands the metric score for flood hazard maps were both in the "above average" range. This is likely to be because in France and the Netherlands the flood maps included in the plans often include the maximum flood depth and sometimes maximum flood velocity. In England and Wales only the maximum flood extent is generally shown.

The type of flood hazard maps available was also mentioned by the stakeholders engaged by the research team. Many stated that maps showing maximum depths and velocities for different flood scenarios would be useful to them if they could be made available. In England and Wales it should be possible to produce such maps in areas where two dimensional hydraulic modelling has been carried out. Similarly in France there was a stated desire to have more detailed flood maps in terms of the mapped hazard.

(iii) Risks to people

In terms of metric scores the Netherlands had the highest score on risk to people. This may be partly as a result of the fact that researchers in the Netherlands have pioneered methods to assess injuries and loss of life due to flooding and that a sudden failure of flood defences could result in a large number of fatalities. In France and England and Wales there was "room for improvement" in the treatment of risk to people, particularly vulnerable groups.

(iv) Critical infrastructure

In all three countries there appeared to be a lack of information in plans on critical infrastructure with this metric having an average score of 1.15, 1.8 and 1.6 in England and Wales, France and the Netherlands respectively. With regards to critical infrastructure it was clear from the research undertaken with the stakeholders in England that they saw "potential damage to critical infrastructure" and the "interdependence between at risk critical infrastructure" (e.g. the failure of an electrical substation affecting a water treatment works) as being important to include in Multi Agency Flood Plans. However, this information was often not readily available to emergency planners.

(v) NaTech hazards

In England and Wales there was only one plan that showed the location of industrial facilities in the floodplain. In France the metric for NaTech hazard scored higher than for the Netherlands and England and Wales; this is likely to be because the PCS plans in France have a legal requirement to cover technological hazards.

(vi) Accessibility of roads

In France and England and Wales there was great emphasis given by the stakeholders on the accessibility of roads. The feedback on the emergency plan that was used recently in the Cumbrian floods was that maps showing potential road inundation outside the "formal Environment Agency Flood Map" were of great use to emergency responders. In some regions of France methods are being developed specifically to assess the inundation of roads to assist emergency planners with their response.

8 References

ALEXANDER, D (2002) Principles of emergency planning and management, Terra Publishing, Harpenden and Oxford University Press, New York

ALEXANDER, D (2003) Towards the development of a standards in emergency management training and education, Disaster Prevention and Management Vol. 12 No. 2 pp 113-123

ALEXANDER, D (2005) Towards the development of a standard in emergency planning Journal of Disaster Prevention and Management Vol.14 No. 2, 2005

BROWN, D AND ROBINSON, D (2005) Development of metrics to evaluate effectiveness of emergency response operations 10th International Command And Control Research And Technology Symposium The Future Of C2

DRABEK, T. E. AND HOETMER, G.J. (1991) Emergency management: Principles and practice for local government, International City Management Association, Washington DC, USA

DEFRA (2008) A National Flood Emergency Framework Proposals for consultation, December 2008

DIRECTION DE LA DEFENSE ET FE LA SECURITIE CIVILES (2004) Plan communal de Sauvegarde – Guide Practique D'Elaboration

DIRECTION DE LA DEFENSE ET FE LA SECURITIE CIVILES (2006) Guide ORSEC Départemental – Méthode générale – Tome G.1 – Décembre 2006

ENVIRONMENT AGENCY/DEFRA (2008) Developing a Multi-Agency Flood Plan (MAFP) Guidance for Local Resilience Forums and Emergency Planners February 2008 version 4.4

ENVIRONMENT AGENCY/DEFRA/CIVIL CONTINGENCIES SECRETARIAT (2009) Checklist for Multi-Agency Flood Plans (MAFP) 15 December 2009

ERLICH M. (2007) OSIRIS – An example of citizen-oriented technology development in the area of dissemination of information on flood risk management, in Begum S. *Flood Risk Management in Europe*, Springer p. 107-129.

QUESTIONPRO (2009) Question Pro Survey software [WWW] http://www.questionpro.com/ (accessed 11 January 2009)

LARSSON, A (2008) A framework for evaluating emergency preparedness plans and response strategies Interim Report IR-08-008 International Institute for Applied Systems Analysis, Austria [WWW] http://www.iiasa.ac.at/Admin/PUB/Documents/IR-08-008.pdf (accessed 25 January 2009)

MINISTERIE VAN BINNENLANDSE ZAKEN EN KONINKRIJKSRELATIES (2009) De veiligheidsregio, Wet veiligheidsregio's: hoe, wat en waarom?

MINISTERIE VAN BINNENLANDSE ZAKEN EN KONINKRIJKSRELATIES (2008) Nationaal crisisplan Hoogwater en overstromingen, Beleidsdraaiboek; Operationele strategie; Communicatiestrategie

TASKFORCE MANAGEMENT OVERSTROMINGEN (2009) Rapport van Bevindingen

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Appendix A Details of the review of Multi-Agency Floodplains in England and Wales

Introduction

Flood emergency plans are dynamic documents that are often being updated. It is therefore important to note that many Local Resilience Forums are still in the process of producing MAFPs and this together with issues of confidentiality in some cases, limited the number of MAFPs that were readily available to review.

It is important to note that when the metrics were applied to assessing flood emergency plans if an item was not included but the reason for its lack of inclusion was fully justified then the particular metric was assessed as being of medium level of detail.

It is important to note that some of these metrics (e.g. evacuation routes) might be included in complementary plans. However, if they are included in these complementary plans it is often not explicitly stated in the MAFPs that this is the case.

Table A1 List of flood emergency plans reviewed for England and Wales

Name of plan	**Date of plan**	**Length of plan (pages)**	**Average score**
Cornwall Emergency Plan	January 2004	Approximately 150	2
Devon Emergency Plan	April 2004	Approximately 250	2.2
Hampshire Flood Response Plan	December 2007 Version 1	28	1.3
Suffolk Multi Agency Flood Plan	March 2009 Issue 2	43	1.5
Walsall Flood Plan	January 2009 Amendment 01/09	24	1.5
Coventry Multi-Agency Flood Plan	Draft 31 March 2009	46	1.8
North Wales Multi-Agency Flood Plan	Version 3 May 2009	227	2.2
Northumberland Local Resilience Forum Multi Agency Flood Plan	Consultation Draft Version 1.0 September 2009	209	2.3
Cumbria Multi-Agency Flood Plan	October 2009	300	2.2
Doncaster Multi-Agency Flood Plan	Version 5 October 2009	117	2.3
Multi-Agency Flood Response Coordination Plan - Ryedale	November 2007 Reviewed: October 2009	120	1.9
Hertfordshire Multi-Agency Strategic Flood Plan	Version 1.6 November 2009	21	1.3
Avon and Somerset	Version 1.9 December 2009	58	2
Average score			*1.9*

Review of Doncaster Multi Agency Flood Plan (MAFP)

Doncaster is a large town in South Yorkshire in the north of England, and the principal settlement of the Metropolitan Borough of Doncaster. According to the 2001 census, the urban sub-area of Doncaster had a population of approximately 68,000 together with Bentley and Armthorpe it forms an urban area with a population of about 128,000. Doncaster is located inland and is not at threat from coastal floods. Version 5 of the Draft Doncaster MAFP was produced in October 2009 and stretches to 117 pages. The Doncaster MAFP is a well put together comprehensive plan. Although it does not include any flood maps it clearly states that the maps have deliberately not been included in the MAFP owing to their size and volume. The plan also clearly states that the maps are readily available to the relevant stakeholders in electronic (GIS format) and hard copy. Table A1 provides a brief review of the Doncaster MAFP using the metrics developed as part of FIM FRAME the plan was found to be "Above average".

A2 Review of version 5 of the Draft Doncaster Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods			●	3
Flood hazard map		●		2
Flood Warning			●	3
Risk to people	●			1
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business	●			1
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards	●			1
Evacuation routes		●		2
Shelters/Safe havens		●		2
Relationship with complementary emergency plans			●	3
Communication with other agencies			●	3
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan			●	3
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery		●		2
Training and exercises		●		2
			Average score	2.3
			Rating	"Above average"

Review of Northumberland Local Resilience Forum Multi Agency Flood Plan

Northumberland is located in the north-east of England. It borders Cumbria to the west, County Durham to the south and Tyne and Wear to the south east, as well as having a border with Scotland to the north, and the North Sea to the east. Its location in England is shown in Figure A1. In 2008 Northumberland had an estimated population of some 311,000 people. It is clearly stated in the plan that "*this plan only provides a response to the threat of fluvial and coastal flooding within Northumberland. It is our intention to develop the Action Plan further by detailing a response to surface water flooding, during the December 2010* *review.*" The Northumberland Multi Agency Flood Plan (MAFP) is a well put together comprehensive plan. The review of the plan is summarised in Table A2.

The plan has very few areas which could be classified as needing "room for improvement". The two areas where this was found to be the case was in the assumptions made by the plan which do not seem to be clearly stated anywhere and the possibility of NaTech hazards occurring as the result of flooding. Using the metrics developed the Northumberland MAFP was found to be "Above average".

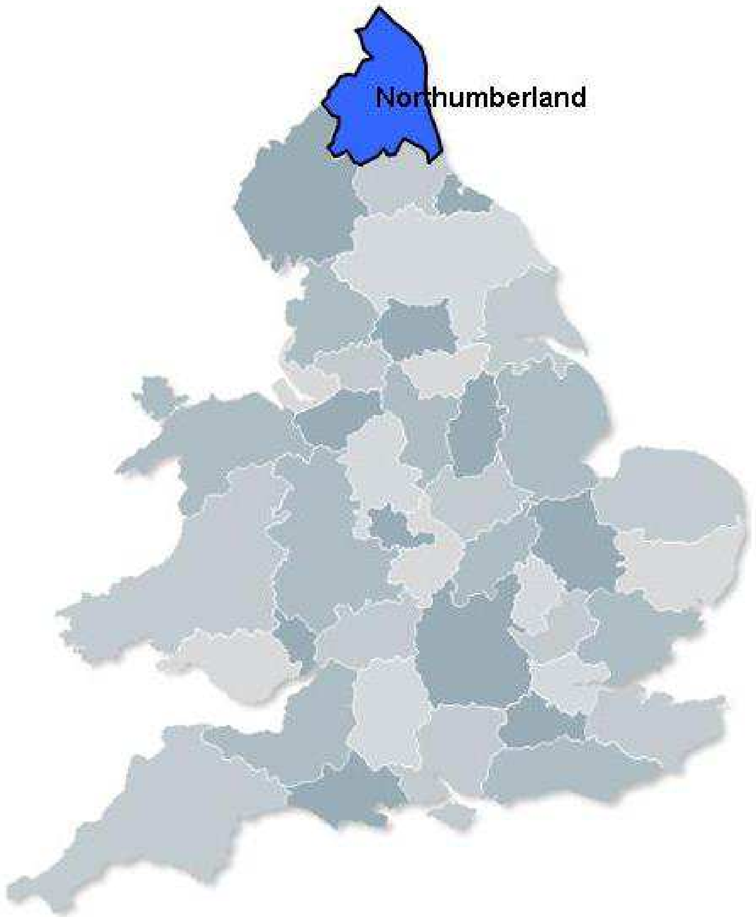

Figure A1 Location of Northumberland in England and Wales

Table A3 Review of Northumberland Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods		●		2
Flood hazard map		●		2
Flood Warning			●	3
Risk to people		●		2
Risk to vulnerable people			●	3
Flood risk to residential properties		●		2
Flood risk to business		●		2
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards	●			1
Evacuation routes		●		2
Shelters/Safe havens		●		2
Relationship with complementary emergency plans			●	3
Communication with other agencies			●	3
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery			●	3
Training and exercises		●		2
			Average score	2.3
			Rating	“Above average”

Review of Ryedale Multi Agency Flood Response Co-ordination Plan

Ryedale is a non-metropolitan district of the county of North Yorkshire in northern England. In 2008 Ryedale was estimated to have a population of 53,800. The Ryedale area is not subject to flooding from the coast. Although the Ryedale Multi- Agency Flood Response Plan is a well put together plan it only rates as an “average” plan using the metrics this because there are a number of items including flood risk to people and buildings that are not detailed in the plan. A summary of the review of the Ryedale plan is given in Figure A2.

Table A4 Review of Ryedale Multi-Agency Flood Response Co-ordination Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods			●	3
Flood hazard map		●		2
Flood Warning			●	3
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties		●		2
Flood risk to business	●			1
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public	●			1
Management of the media		●		2
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities			●	1
Recovery		●		2
Training and exercises		●		2
			Average score	1.9
			Rating	"Average"

Review of Coventry Multi Agency Flood Plan

Coventry is a city and metropolitan borough in the county of West Midlands in the centre of England. Coventry is the ninth largest city in England and as of 2008 had an estimated population of 309,800. The area covered by Coventry City Council's boundary has not historically been subject to significant flooding. However, Environment Agency maps have disclosed areas of risk. Although most of Coventry is not a significant risk from fluvial flooding this MAFP would have benefited from the inclusion of flood maps or at least a reference to the flood maps that have been produced as part of the Strategic Flood Risk Assessment. There is room for improvement in the Coventry plan especially with respect to giving more details of the type and location of the receptors that are at risk from flooding. This information should be readily available. The review of the Coventry Plan is given in Table A3.

Table A5 Review of Coventry Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods			●	3
Flood hazard map	●			1
Flood Warning		●		2
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans	●			1.5
Communication with other agencies	●			1
Communication with the public	●			1.5
Management of the media	●			1.5
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises	●			1
			Average score	1.8
			Rating	"Room for improvement"

Review of Suffolk Multi Agency Flood Plan

Suffolk is a non-metropolitan county in the east England. It has borders with Norfolk to the north, Cambridgeshire to the west and Essex to the south. The North Sea lies to the east. The county town is Ipswich. The county is low-lying with few hills, and has in the past (e.g. 1953) been subject to serious coastal flooding. Suffolk had an estimated population of about 716,000 in 2008. The location of Suffolk in England is shown in Figure A2. The Suffolk Multi-Agency Flood Plan was produced in March 2009. The summary of the metrics is given in Table A4. The plan contains a considerable amount of generic text and would benefit from being more specific. The flood mapping presented is fairly limited but this may be because there is more detailed mapping at a more localised level covered by other plans. The plan would benefit from employing the document "Developing a Multi-Agency Flood Plan". Similar to the Coventry plan there is a lot of useful information concerning receptors and there exposure to the flood hazard that could be added.

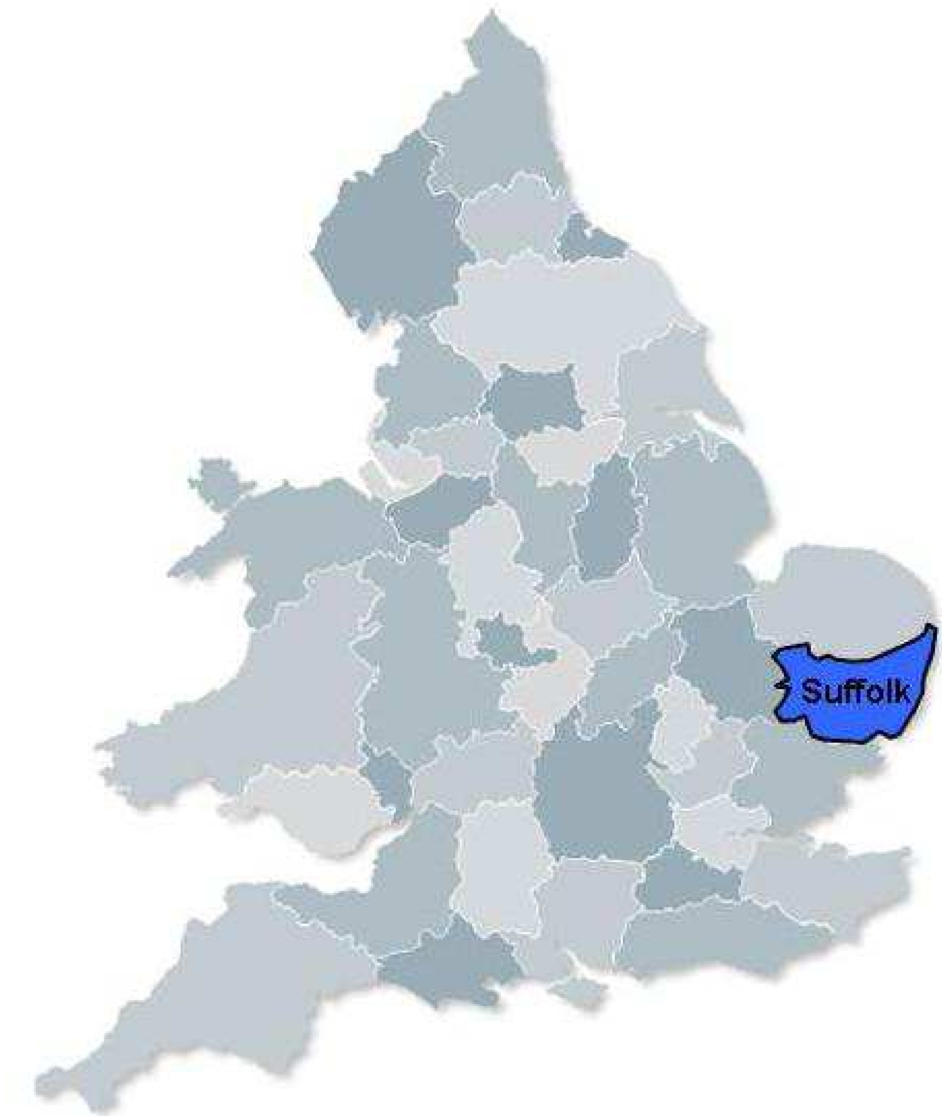

Figure A2 **Location of Suffolk in England and Wales**

Table A6 Review of Suffolk Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods			●	3
Flood hazard map		●		2
Flood Warning		●		2
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans	●			1
Communication with other agencies		●		2
Communication with the public	●			1
Management of the media	●			1
Assumptions made by the plan	●			1
Plan activation	●			1
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises		●		2
			Average score	1.5
			Rating	“Room for improvement”

Review of Hertfordshire Multi Agency Flood Plan

Hertfordshire is located immediately to the north of Greater London. The location of Hertfordshire is shown in Figure A3. The 2001 census indicated that Hertfordshire has a population of some 1,034,000 people. There is no threat of coastal flooding in the county. Version 1.6 of the Hertfordshire Multi-Agency Flood Plan (MAFP) was produced in November 2009. The plan is 21 pages in length and is fairly brief in its details. This may be because flooding is not seen as a major issue in Hertfordshire. Table A5 provides details of the review of the Hertfordshire MAFP using the FIM FRAME developed metrics. The metrics indicate that there is “Considerable room for improvement” in the plan. The details of many of the key issues in the plan are fairly limited. There is room for considerable improvement in the plan. One way in which the plan could be improved is by the addition of additional maps and figures at a suitable scale. It may be that these figures exist in a digital format (e.g. GIS) or are presented in other complementary plans. However, if these are available it is not stated in the plan. The plan could also benefit from following the “templates” and “models” that are detailed in the document called “Developing a Multi-Agency Flood Plan” produced by Defra/Environment Agency in 2008.

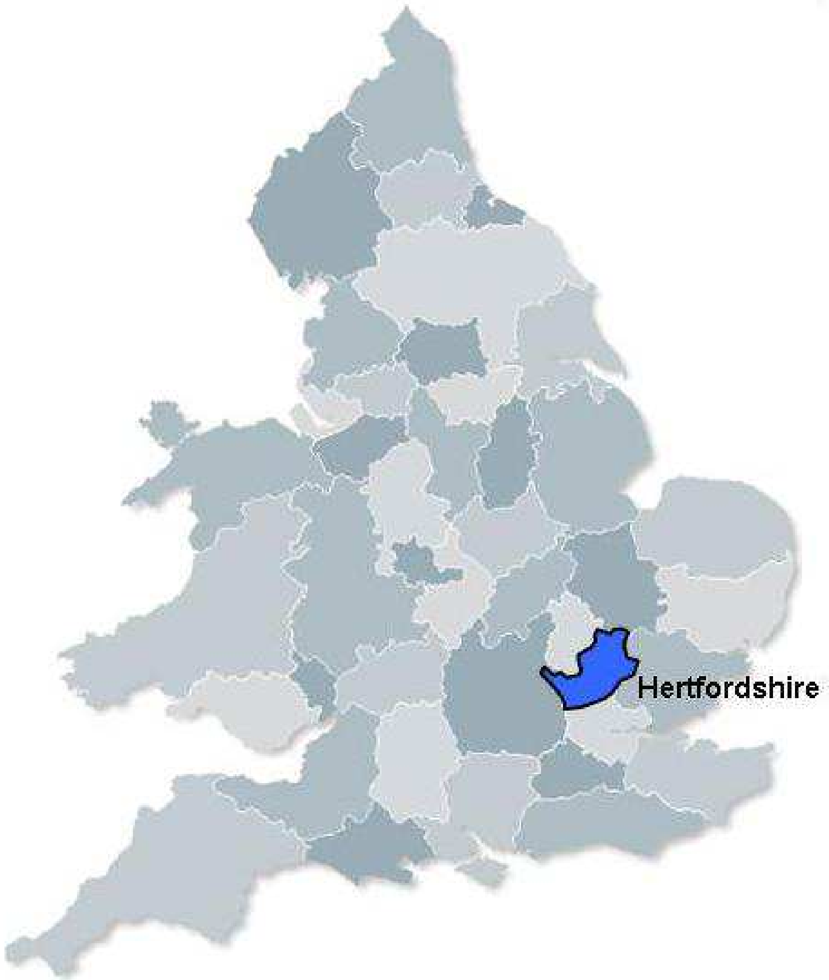

Figure A3 Location of Hertfordshire in England and Wales

Table A7 Review of Hertfordshire Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map		●		2
Flood Warning	●			1
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties		●		2
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1.5
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public	●			1
Management of the media	●			1
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities	●			1
Recovery	●			1
Training and exercises	●	●		1
			Average score	1.3
			Rating	"Considerable room for improvement"

Review of Cumbria Multi Agency Flood Plan

Cumbria is a non-metropolitan county in the north west of England. The county consists of six districts, and in 2007 had a total population of 498,800. The county is bounded to the west by the Irish Sea. It is a predominantly rural county; Cumbria is much of the county is mountainous. All the mountains in England that are over 900 m above sea level are in Cumbria. In November 2009 it was subject to a series of flash floods. The location of Cumbria in England is shown in Figure A4. The key sources of flooding in order of risk are stated by the plan to be:

- Localised surface water i.e. road drainage/Sewer flooding;
- Main river/Ordinary watercourses;
- Tidal;
- Canal related problems;
- Reservoir related problems.

The MAFP that covers Cumbria is a comprehensive document that stretches to 300 pages. The plan is well put together covering almost all the key issues apart from evacuation. Table A6 provides an overall summary of the review of the plan which was found to be “above average” using the metrics that were developed.

Table A8 Review of Cumbria Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods			●	3
Flood hazard map		●		2
Flood Warning			●	3
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business		●		2
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards		●		2
Evacuation routes	●			1
Shelters/Safe havens		●		2
Relationship with complementary emergency plans			●	3
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media	●			1.5
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery			●	3
Training and exercises		●		2
			Average score	2.2
			Rating	“Above average”

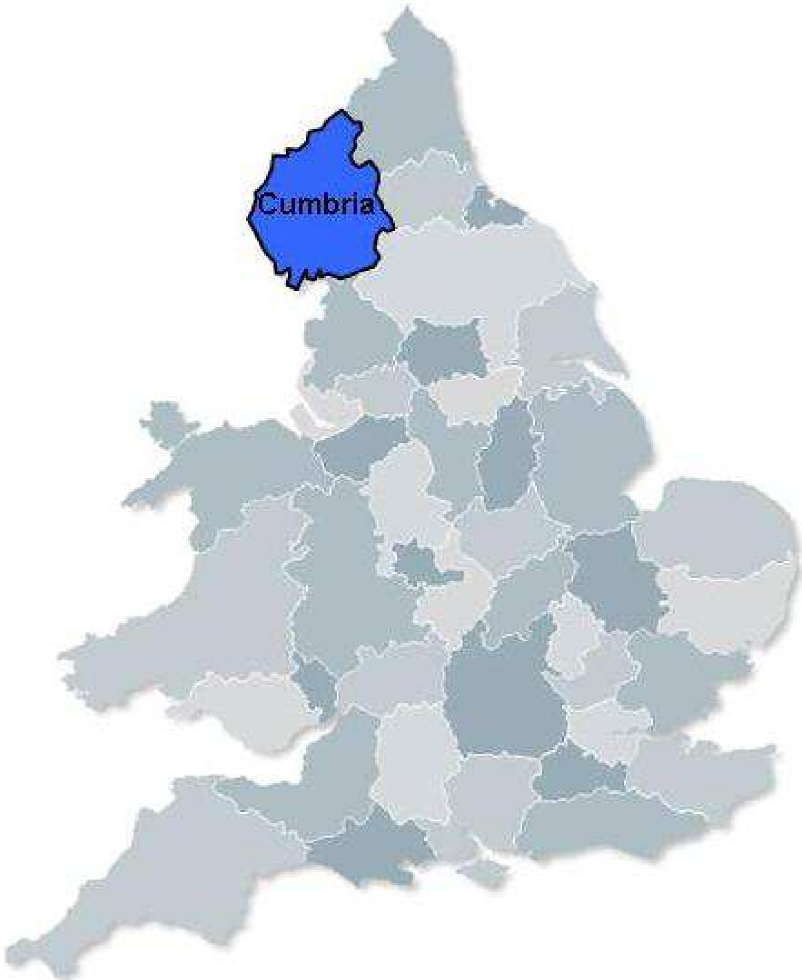

Figure A4 Location of Cumbria in England and Wales

The plan was put into practice in the recent November 2010 floods. Feedback on the plan during these floods can be summarised as follow:

Positive points

The following provides a summary of the positive points that were made about the plan after the flood:

i. 'The Risk of Flooding' was the most used section of the plan by responders and at 'Gold' Command. The information on the maps particularly the local infrastructure, location of substations, care homes was stated to be very useful.
ii. Splitting the information into District Council Sections was seen to be useful rather than just into catchments as was the separation of fluvial and tidal flooding.
iii. The inclusion of maps showing flooding "hot-spots" and roads liable to inundation outside the formal Environment Agency Flood Map.
iv. A good 'Actions Roles and Responsibilities' section together with resource forms.
v. The MAFP was seen to complement the Cumbria General Emergency Plan well with only limited duplication
vi. The plan was found to be compact and information in it was relatively easy to locate.

Negative points

The main negative point expressed was that the maps in the MAFP were not large enough and many responders felt it would be easier to annotate a suite of larger maps.

Room for improvement

Areas were it was felt that the MAFP could be improved included:

- Flood maps showing Flood Zones 2 and 3 beyond the Flood Warning;
- The inclusion of larger maps or maps showing more detail;
- The addition of maps of some areas highlighted as “hotspots” or which have a high flood risk and flooding history;
- The inclusion of the flood maps on an integrated GIS system;
- Provision of a link to reservoir inundation plan.

Review of Avon and Somerset Multi Agency Flood Plan

Avon and Somerset is located in the west of England, as shown in Figure A5 and has an estimated population of some 1.5 million people. Avon and Somerset is at risk from both coastal and fluvial flooding. The Avon and Somerset MAFP is a 58 page document. Version 1.9 of this plan was released in December 2009. This was one of the few plans reviewed where the assumptions in the plan are well set out and documented for generic, fluvial, tidal and pluvial flooding.

Table A7 provides a review of the Avon and Somerset MAFP. It ranks as an “average” MAFP. There are several positive aspects to it; however, there is a lot of generic text and mention of the use of Local Authority Flood Plans. The MAFP does not include any form of flood hazard map. Although these are likely to be included in Local Authority Flood Plan if widespread flooding were to take place in Avon and Somerset it would be useful if the MAFP also included maps. The MAFP would then act as a “repository” for maps and the overall flood hazard could be more easily assessed by the responders.

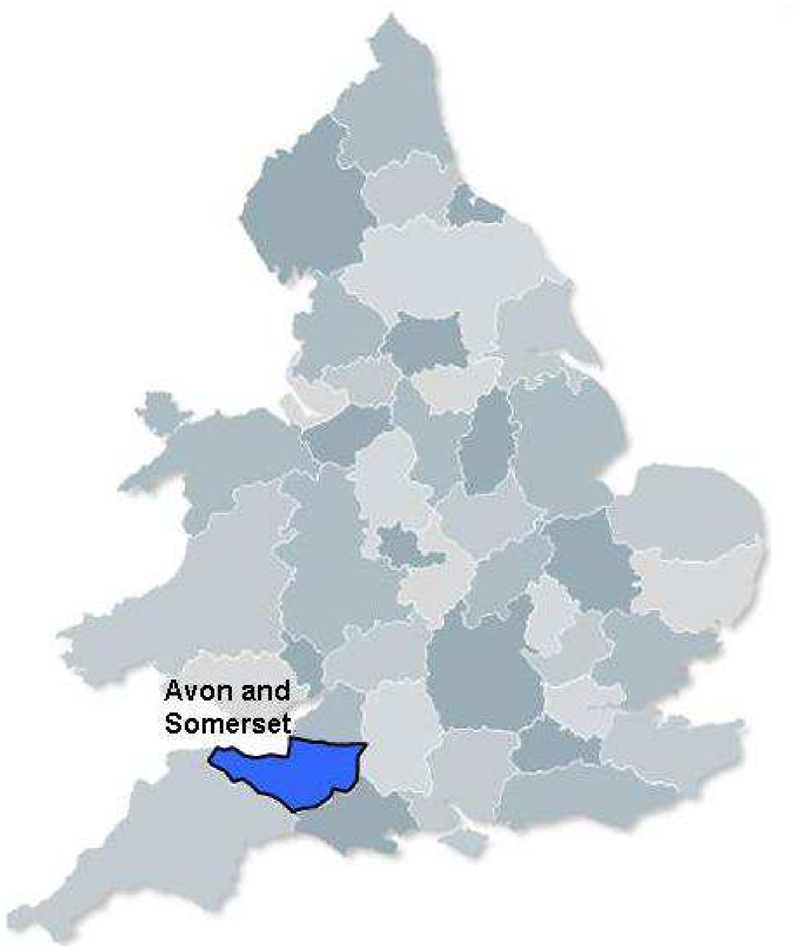

Figure A5 Location of Avon and Somerset in England and Wales

Table A8 Review of Avon and Somerset Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map	●			1
Flood Warning	●			1
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business		●		2
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards		●		2
Evacuation routes			●	3
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media			●	3
Assumptions made by the plan		●		2.5
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery			●	3
Training and exercises		●		2
			Average score	2
			Rating	“Average”

Review of Cornwall Multi-Agency Flood Response Plan

The version of the Cornwall MAFP reviewed here was produced in 2004. It is very likely that this document has been updated on a number of occasions over the past six years; however, more recent versions were not available to the project team. Cornwall forms the tip of the south-western peninsula of England. It is bordered to the north and west by the Atlantic Ocean, to the south by the English Channel, and to the east by the county of Devon. The location of Cornwall is shown in Figure A6. In 2008 Cornwall was estimated to have a population of some 534,000 people.

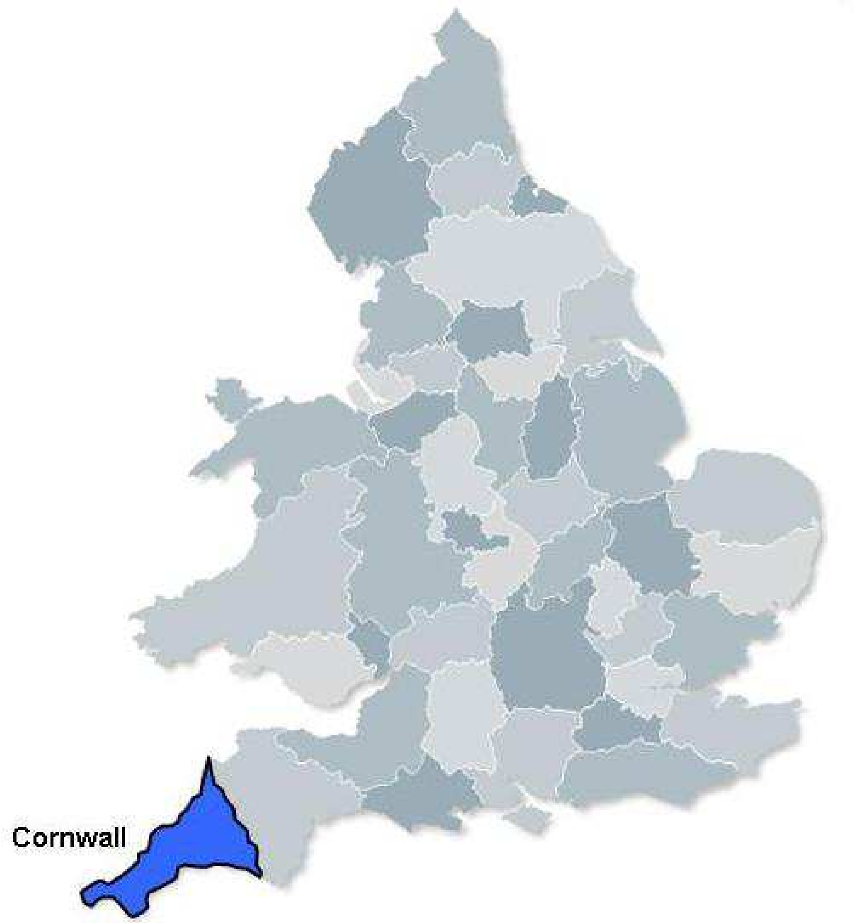

Figure A6 Location of Cornwall in England and Wales

Table A8 provides the ranking for the Cornwall Multi Agency Flood Response Plan. Although the Cornwall MAFP only ranks as an “average” plan it has to be borne in mind that the plan reviewed is almost six years old and will have been updated. The plan reviewed incorporated and made reference to comprehensive maps showing the location of evacuation routes, rest centres and also roads likely to flood. In this respect it provides more details than many of the other more recently produced MAFPs that have been reviewed as part of the research. The Cornwall MAFP also provides examples of flood maps annotated with “local knowledge” that could be of significant use to responders during a flood event. An example of one of these maps is shown in Figure A7. Although the 2004 MAFP is only rated as “average” it would not require too many additions to increase its rating to “above average”.

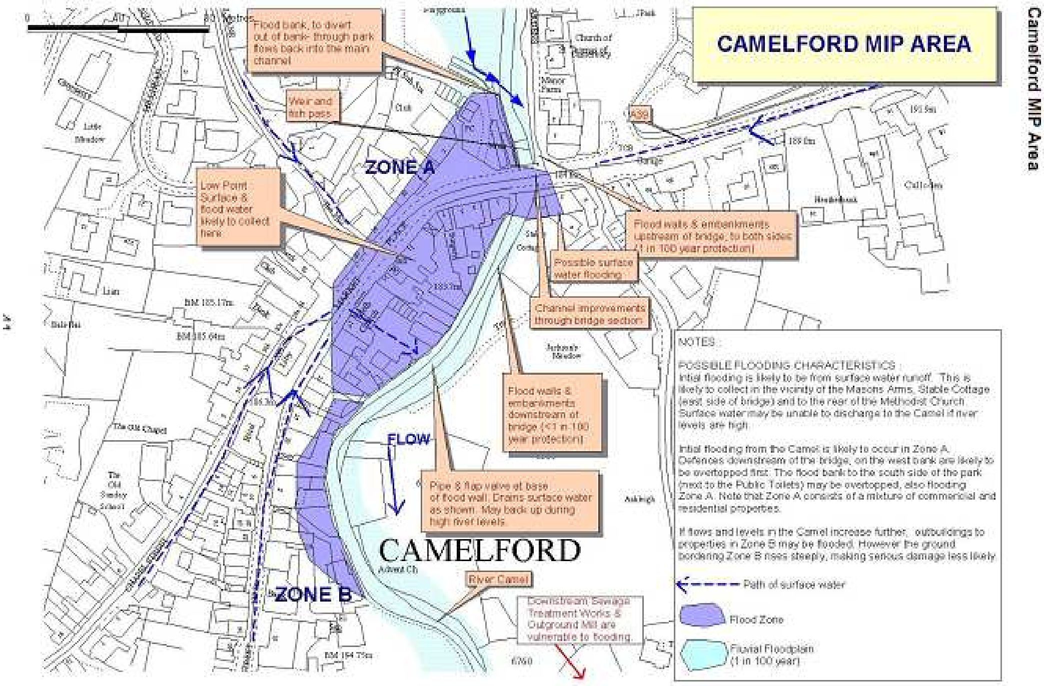

Figure A7 **Typical example of a flood map featured in the Cornwall MAFP**

Table A9 Review of Cornwall Multi-Agency Flood Response Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods		●		2
Flood hazard map		●		2
Flood Warning			●	3
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business		●		2
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes		●		2
Shelters/Safe havens			●	3
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media			●	3
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises		●		2
			Average score	2
			Rating	"Average"

Review of Devon Flood Warning and Response Plan

Devon is the third largest of the English counties and in 2008 had an estimated population of 1,142,000. The location of Devon in England is shown in Figure A8. It is subject to fluvial, flash and coastal flooding. The Devon Flood Warning and Response Plan was produced in April 2004. Similar to the Cornwall MAFP it is likely that this plan will have been updated over the past six years; however, more recent versions were not available to the project team. The map part of the plan excluding maps and Appendices stretches to 196 pages and is well set out. The review of the Devon plan is given in Table A9. Although produced over five years ago the Devon Plan ranks as "above average" and includes much information that is lacking from many of the other MAFPs, for example, the location of facilities in the floodplain such as oil depots and chemical facilities that may lead to a NaTech hazard.

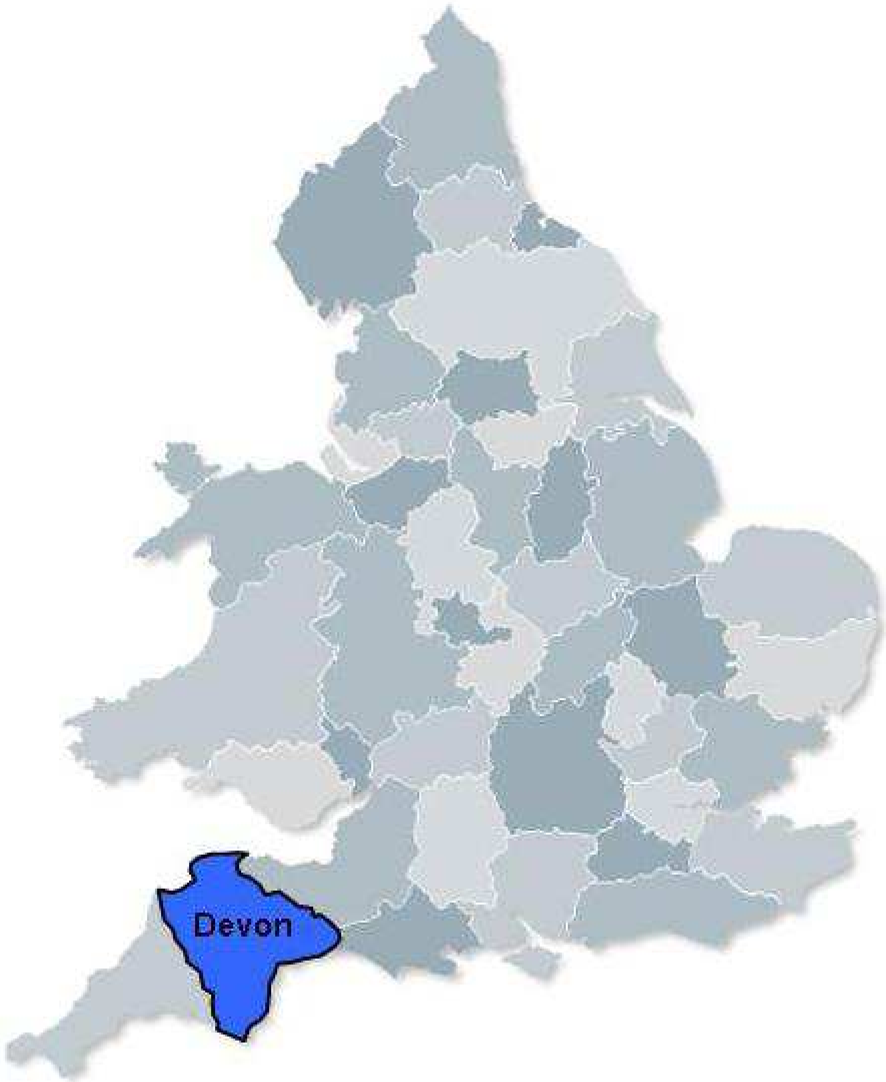

Figure A8 **Location of Devon in England and Wales**

Table A10 Review of Devon Flood Warning and Response Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating			●	3
Details of previous floods		●		2
Flood hazard map		●		2
Flood Warning			●	3
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business		●		2
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards		●		2
Evacuation routes		●		2
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2
Communication with other agencies			●	3
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan		●		2
Plan activation		●		2
Actions, roles and responsibilities			●	3
Recovery		●		2
Training and exercises		●		2
			Average score	2.2
			Rating	"Above average"

Review of the Hampshire Flood Response Plan

Hampshire is a county on the south coast of England. The county borders Dorset, Wiltshire, Berkshire, Surrey and West Sussex. The county has an area of 3,700 km^2. In 2008 the population of Hampshire was estimated to be approximately 1.7 million. Version 1 of the Hampshire flood response plan produced in December 2007 stretches to 28 pages. As Table A10 below shows the Hampshire Flood Response Plan has very little detail on the effects of flooding on a variety of receptors and as such it scores a relatively low mark and thus is rated as being plan with "considerable room for improvement".

Table A11 Review of Hampshire Flood Response Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map	●			1
Flood Warning	●			1
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies	●			1
Communication with the public	●			1
Management of the media	●			1
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises		●		2
			Average score	1.3
			Rating	"Considerable room for improvement"

Review of the Walsall Flood Plan

Walsall is a large industrial town in the West Midlands of England. It is located northwest of Birmingham and east of Wolverhampton. In 2008 it had an estimated population of some 175,000. The Walsall Flood Plan was produced in January 2009. It is an addendum to the major emergency plan for the town. It stretches to 24 pages. Similar to the Hampshire Flood Response Plan it has a lot of generic text but few diagrams. This is one of the reasons that it gained a low score and was rated as a plan with "Room for improvement".

Table A12 Review of Walsall Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map		●		2
Flood Warning		●		2
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media	●			1
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises	●			1
			Average score	1.5
			Rating	"Room for improvement"

Review of the North Wales Multi-Agency Flood Plan

The Multi Agency Flood Plan for North Wales has been developed to collate information relating to the roles and responsibilities of organisations that respond to flooding across North Wales in order to improve the multi-agency response and co-ordination of resources during a flooding incident. In its current form, the MAFP provides the first attempt to a means of a Multi Agency Approach to flooding which sets out the generic roles and responsibilities of those involved as well as the planning and response to flooding in those highest flood risk areas across North Wales. The area covered by this plan is shown in Figure A9. The plan is currently in the process of being updated. Table A12 provides the scoring for the metrics for the North Wales MAFP. The MAFP is well put together. The MAFP would have been classified as an "above average" plan if there had been some information on "evacuation routes", "assumptions" and "recovery".

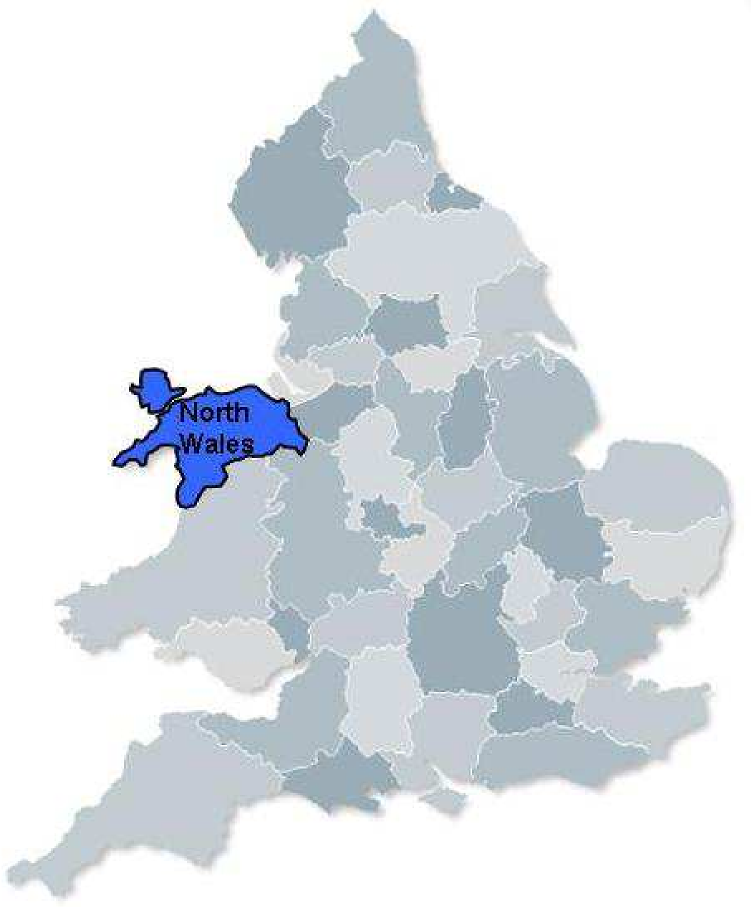

Figure A9 Location of North Wales in England and Wales

Table A13 North Wales Multi-Agency Flood Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	2
Target audience and updating			●	2
Details of previous floods			●	3
Flood hazard map		●		2
Flood Warning			●	3
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business			●	3
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards		●		2
Evacuation routes	●			1
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2.5
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery	●			1
Training and exercises			●	3
			Average score	2.2
			Rating	“Average”

Appendix B Details of the review of emergency flood plans in France

Introduction

Brief details of these metrics are given in Table 4.3. The plans are ordered according the date of when the plans were first produced. For comparison, two others plans have been assessed. These are the “Dispositif Orsec Zone de Défense de Paris” (DOZDParis) and the Plan de Decours Specialise Inondations Loire (PSSIL) which is a specific emergency plan for floods in the Loire River catchment. These have been compared with a PCS at local scale within the relevant area. The Nanterre PCS has been compared with the DOZDParis and the Brives-Charensac PCSis compared to PSSIL.

Table B1 List of emergency plans reviewed for France

Name of plan	Type of plan	Date of reviewed version	Length of plan (pages)	Average score
Blagnac PCS	Plan Communal de Sauvegarde	2002 updated 2009	58	1.8
Quissac PCS	Plan Communal de sauvegarde	2006	25 plus appendices	2.2
Perpignan PCS	Plan Communal de Sauvegarde	June 2006	192 plus maps	2
Metz PCS	Plan Communal de Sauvegarde	September 2007	69	2
Brives-Charensac PCS	Plan communal de Sauvegarde	September 2007	6.	2
Plan de Secours Spécialisé Inondation Loire	Emergency plan for the upstream part of the Loire River catchment	2004 updated 2009	23	1.9
Nanterre PCS (local emergency plan)	Plan communal de sauvegarde	2007	104 plus appendices	2.1
Le Cailar PCS	Plan Communal de Sauvegarde	October 2007	26 plus appendice	2.4
Nice PCS	Plan Communal de sauvegarde	31 October 2007	24 appendices	2
Cléry Saint-André PCS	Plan Communal de Sauvegarde	2009	613	2.4
Nancy PCS	Plan Communal de Sauvegarde	2009	49	1.4
Saint Raphael PCS	Plan Communal de Sauvegarde	2009	142	1.5
Piolenc PCS	Plan Communal de Sauvegarde	April 2009	122	1.4
Sommières PCS	Plan Communal de Sauvegarde	17 April 2009	87	2
Dispositif Orsec	Regional Emergency plan	October 2009	23 plus	2.1

Zone de Défense de Paris	region Ile-de-France	Draft version	appendices	
Tarascon PCS	Plan Communal de Sauvegarde	2006 updated in November 2009	92 plus appendices	1.8
Average score				*2*

Review of the Blagnac plan communal de sauvegarde according to the metrics

Name of plan	Plan Communal de Sauvegarde de la Ville de Blagnac (Haute-Garonne – 31).
Name of geographical area covered by the plan:	City of Blagnac.
Date when the plan was produced:	March, 2002. Updated in 2009
Approximate area covered by the plan:	Area : 16,88 km². Area prone to flood : 3 km² (300ha)
Approximate number of people living in the area covered by the plan.	21 199 inhabitants (2006). Inhabitants prone to flood: 2 000 maximum.
Length of the plan:	58 pages.
Aim of the plan:	Setting up of an organisation to handle crisis
Brief comments:	Multirisk plan including natural and technological hazards. Detailled scheme of ableau très détaillée dans les niveaux d'alerte selon la côte du cours d'eau et les actions à mener en conséquence.

Blagnac is a town of south-western France located in the urban area of Toulouse. 21 199 inhabitants lived in Blagnac in 2006. The city is concerned with flood risk and industrial risk owing to the airport which had attracted some industries especially a stock of oil and gasoline Groupement d'Avitaillement pour Toulouse (G.A.T.). The commune is also prone to dam failure and transportation of dangerous goods.

Concerning flood hazard, Blagnac is exposed to the flooding of Garonne River. The reference in this matter was the flood of 21^{st} to 24^{th} June 1875 who triggered a huge death tool (500 fatalities which 9 of them in Blagnac). The fatalities were mainly due to building collapsing.
In 1952 and 1977 floods caused much damage but not fatalities the flood prone zone stretches over 3 km^2 and affects 2000 persons. The section of Garonne River which streams across Blagnac is bordered by a dike system built after the 1930 event. New dikes were erected in 1973 and 1974 and have just been heightened for 25 cm. Dikes are a shortcoming in flood defence. In 1977, properties located behind the dike had been flooded.

The PCS is as many a multi risk plan. The version we assessed is the synthetic one which is disseminated online to the population. The PCS is very practical and "operational" and focuses on the water level threshold and the action to be carried out according those levels. The census of assets (flood risk to people economical assets….) and potential damage is poor as in many others PCS. Unless the note suggests room for improvement, (the "score" is 1.8), the handling of a crisis seems to be well addressed by the municipal authorities.

Table B2 Review of Blagnac plan communal de sauvegarde according to the metrics

Metric	Poor	Acceptable	Good	Score
Aims and objectives of plans		●		2,5
Target audience and updating		●		2
Details of previous floods			●	3
Flood hazard map	●			1
Flood Warning	●			1,5
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens			●	3
Relationship with complementary emergency plans	●			1,5
Communication with other agencies		●		2
Communication with the public		●		2
Managment of the media	●			1
Assumptions made by the plan		●		2
Plan activation			●	3
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises		●		2
			Average	**1.8**

Figure B1 The location of Blagnac

Review of Quissac plan communal de sauvegarde

Name of plan	Plan Communal de Sauvegarde of Quissac
Name of geographical area covered by the plan:	City of Quissac.
Date when the plan was produced:	July, 2006.
Approximate area covered by the plan:	23.32 km².
Approximate number of people living in the area covered by the plan.	2 569 inhabitants in 2006.
Length of the plan:	200 pages.
Aim of the plan :	Define the organization and the action strategies to implement in view of any crisis.
Brief comments:	Plan organized according to three booklets: Communal Organization and Procedures of the crisis management, a graduated intervention plan for flood management and an appendix with, a report/account of meetings, a directory of crisis…

The commune of Quissac is located in southern France. 2569 people lived there in 2006. This is a rural commune only the old village centre is prone to floods. Quissac is prone to the torrential flood of Vidourle River and the Garonnette catchment (2 km^2 but specific discharge exceeds 10 $m^3/s/km^2$ during hugest floods). One elderly person died during the 9th September 2002 floods downstream the Garonnette basin. The PCS has been drawn in December 2006 by a consultant called predict services who is specialized in setting up such plans. The maps are very accurate and numerous (11 maps).

There are two can of maps: maps representing elements at risk such as flood prone houses and major assets at risk The other kind of maps are “action Maps” i.e. maps that that draw the different actions to do in case of crisis (to close different street, to supervise both rivers.

Nevertheless, for some items, maps could be more accurate e.g. the sheltering, or risk to vulnerable people although the authorities have got an updated list of vulnerable people.

The length of the hard copy seems good neither too long (not easy to use in case of crisis) and neither too short by overlooking some important details. A training exercise was hold in 2006 the 21st of September. A short report lessens this exercise in the PCS.

The average note is rather high owing to the use of many maps.

Table B3 Review of the PCS of Quissac according to the metrics

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map		●		2.5
Flood Warning			●	3
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business		●		2
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards			●	3
Evacuation routes		●		2
Shelters/Safe havens		●		2
Relationship with complementary emergency plans	●			1
Communication with other agencies			●	3
Communication with the public			●	3
Management of the media	●			1
Assumptions made by the plan		●		2
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery		●		2
Training and exercises			●	3
			Average	**2.2**

Figure B2 The location of Quissac

Review of Perpignan plan communal de sauvegarde

Name of plan	Plan Communal de Sauvegarde City of Perpignan.
Name of geographical area covered by the plan:	City of Perpignan
Date when the plan was produced:	June 2006
Approximate area covered by the plan:	68,07 km².
Approximate number of people living in the area covered by the plan.	116 041 inhabitants (2007). People at risk : First scenario : 631 inhabitants Second scenario: 3 610 inhabitants Third scenario: 17 098 inhabitants Fourth scenario: 18 528 inhabitants
Length of the plan:	191 pages
Aim of the plan:	This operational document is intended to help the inhabitants in case of flood (by a river or by rain). It allows to persons to know where they are within the crisis organization and knowing how realized the actions to do according to every scenario.
Brief comments:	The document, only dedicated to floods is divided into seven separated folders (crisis organization, decisional cell, coordination pole, communication pole, switchboard crisis, intervention pole and the

	last one appendix). It addresses four different scenarios (one for a pluvial situation and the three others linked to the overflowing of the river “Têt” for two return periods (50-year, 100-year) and the flood of 1940). Plan very detailed.

Perpignan is a town of French Mediterranean low plain in the region Languedoc-Roussillon. 116,041 people lived in the town in 2007. Three kind of flooding has been identified:

- Fluvial flooding due to Têt River which an about two hundred years return period flood occured in October 1940. Têt River is the main danger (a man died in November 2005).
- The overflowing of several channels streaming through the city (e.g. la Basse, le Grand Vivier, le Ganganeil…);
- Local runoff owing to the overflowing of sewage system.

The PCS was first drawn in 2006. It is very operational with “action cards” very precise and detailed actions according to the level of crisis. According to the “metrics”, the plan is “average”. But we can suppose that it is underestimated given that the good criterion rests on the presence of charts probably available in addition (as we can see it in the information memoranda to the public or the hydraulic study).

Two general scenarios are drawn: fluvial and pluvial flooding. For fluvial case, 3 levels of danger are foreseen depending on water depth and flood extension. Maps are available for each scenario but they are not published.

Table B4 Review of the Perpignan plan communal de sauvegarde according to the metrics

Metric	●	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map		●		2
Flood Warning			●	3
Risk to people		●		2
Risk to vulnerable people	●			1
Flood risk to residential properties		●		2
Flood risk to business		●		2
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes		●		2
Shelters/Safe havens	●		●	3
Relationship with complementary emergency plans	●			1
Communication with other agencies			●	3
Communication with the public			●	3
Managment of the media			●	3
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery	●			1
Training and exercises	●			1
			Average	**2**

Figure B3 The location of Perpignan

Review of the Tarascon plan communal de sauvegarde according to the metrics

Name of plan	Plan Communal de Sauvegarde of Tarascon.
Name of geographical area covered by the plan:	Commune of Tarascon (Bouches-du-Rhône).
Date when the plan was produced:	2006, Last updating in November, 2009.
Approximate area covered by the plan:	73,97 km².
Approximate number of people living in the area covered by the plan.	13 376 inhabitants (2006).
Length of the plan:	92 pages.
Aim of the plan:	Le Plan Communal de Sauvegarde is defined as the first operational response to a danger (natural or technological).
Brief comments:	The plan develops a multirisk approach. An annual updating is planned. The commune is strongly involved in improving the document PCS.

Tarascon is a commune of the South of France with 13376 inhabitants (in 2006) located out of left bank of the Rhone River. It belongs to the department of Bouches-du-Rhône, in the region Provence-Alpes-Cote-d'Azur. The commune of Tarascon is exposed to 2 natural hazards (flooding and forest fires) and 3 technological dangers (industrial plants, transportation of dangerous goods and dam failure. Flood risk is due to the Rhone River, the Vigueirat channel and local urban runoff. The slow rising floods of the rhone river use to occur with complicated scenarios owing to the functioning of some spillway in the dike system

and sometimes aggravated by dike failure like in December 2003. In case of dike failure, quite all the territory of the commune is threatened.
The PCS is multi risk and the assessed version is dated to 2009. The crisis management organisation is set up by cells each of them take in charge an aspect of crisis management (warning, information, assistance to affected people…). A plan for sheltering has been drawn and is available on the city website. Nevertheless, the room for improvement (the score is 1.8) is rather high mainly by disseminating more information to the population. As in many PCS, the mapping of elements at risk is not developed even if the vulnerabilities of the territory are known by the authorities.

Table B5 Review of the Tarascon plan communal de sauvegarde according to the metrics

Metric	Poor	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods	●			1
Flood hazard map	●			1
Flood Warning	●			1.5
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1.5
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1.5
Shelters/Safe havens			●	3
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media			●	3
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery		●		2
Training and exercises	●			1
			Average	**1.8**

Figure B5 Location of Tarascon

Review of the Metz plan communal de sauvegarde

Name of plan	Plan Communal de Sauvegarde de Metz
Name of geographical area covered by the plan:	Ville de Metz
Date when the plan was produced:	September, 2007.
Approximate area covered by the plan:	41,22 km².
Approximate number of people living in the area covered by the plan.	127 498 inhabitants (2006).
Length of the plan:	69 pages.
Aim of the plan:	To set up tools and procedures to face up a crisis at local level
Brief comments:	The document addresses trigger levels, crisis management and Information to population which is completed with the DIRCIM. Protection and prevention methods are also showed

According to the 2006 census, the city of Metz had a population of approximately 127, 498. It is situated in the north-eastern part of France. This town is the prefecture of the department of Moselle and of the metropolitan region of Lorraine.

Metz is located at the junction of the Moselle and the Seille River which undergo slow risings floods on a large plain (what facilitates the interventions in case of emergency). They occur primarily during the winter season (from November to April) with sometimes a worsening factor owing to the melting down of snow (in the Vosges Mountains). The city has undergone since 1950 4 major floods since 1950: December 1947 (reference flood because of the simultaneous rising of the Moselle and Seille Rivers), December 1982, April 1983 and May 1983. The Seille River, tributary of the Moselle knew 2 very important risings in October 1981 and April-May 1983.

Moreover, the city undergoes some urban floods due to the growing surface of impervious areas. Some parts of the town are regularly invaded by waters (small catchments of Vallières, Saint Pierre, Bonne Fontaine and la Cheneau). Thus, flood retention basins and pump has been set up in Metz to reduce the flood risk.

The PCS was drawn in 2007 and uploaded online It Include the DICRIM. The document is an abstract version. The maps for instance have not been included but the document refers to them. The stakes are described in the scenarios by the name of the affected streets what let us suppose that they also come out on maps. Using the metrics developed the Metz PCS was found to be "average".

Table B6 review of the Metz plan communal de sauvegarde according to the metrics

Metric	Poor	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods		●		2
Flood hazard map			●	3
Flood Warning			●	3
Risk to people	●			1
Risk to vulnerable people		●		2
Flood risk to residential properties1		●		2
Flood risk to business1		●		2
Flood risk to critical infrastructure1		●		2
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Managment of the media		●		2
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises		●		2
			Average	**2.0**

Figure B6 The location of Metz

Review of Brives-Charensac plan communal de sauvegarde (PCS)

Name of plan	PLAN COMMUNAL DE SAUVEGARDE
Name of geographical area covered by the plan:	Commune of Brives-Charensac (Haute-Loire, 43)
Date when the plan was produced:	Octobre, 2007
Approximate area covered by the plan:	Area of the commune: 4,87 km²
Approximate number of people living in the area covered by the plan.	(Inhabitants: 4 577 by 03/29/2007). ------- Zone 7 : 300 campers Zone 8: 35 Inhabitants Zone 9 : 380 Inhabitants Zone 10 : 535 inhabitants + 54 children (pupils). ⇨ 1.304 inhabitants
Length of the plan:	67 pages.
Aim of the plan:	Recenser l'ensemble des risques majeurs répertoriés sur le territoire communal ainsi que les dispositifs d'alerte et d'information mis en place par les services municipaux / This document lists the hazards within the municipality and also the warning plans and information set

	up by the municipals authorities in case of crisis.
Brief comments:	Flood risk is also detailed in the Plan de prévention des risques (PPR) approved in 23/12/1998. It analyses the flood hazard for following frequencies: 1 in 10, 1 in 30 and 1in 100 years. Multirisk plan.

Brives-Charensac is a commune of the centre of France which gathers 4118 inhabitants (2006). The commune took advantage of the closeness of le Puy-en-Velay urban area (40000 inhabitants) and the population rose from 2000 to over 4000 between 1962 and 1982. Since 1982, the number of inhabitants has been quite constant. The commune was struck by the flash floods of the Loire River which triggered 9 fatalities in 1980 September the 21st. After those flash floods - the worst since 1750 -, some relocations of flood prone industrial plants were undertaken in the commune. The factories had been relocated in neighbouring communes.
Because of this “recent” disaster, the awareness of flood risk is developed in the commune and the local authorities had drawn a PCS. A local emergency plan existed before the current PCS. With neighbouring communes of Chadrac, Chaspinhac, Coubon and Le Monteil, Brives-Charensac is included in the “plan de secours specialise inondations Loire[3]” (PSSIL). The PSSIL is complementary to the PCS of Brives-Charensac. A description of the PSSIL is given just after.

The Table B7 provides a brief review of the Brives Charensac PCS using the metrics developed as part of FIM FRAME. The plan was found to be just on “average”.

Table B7 Review of the PCS of Brives-Charensac according the metrics

Metric	Room for improvement	Acceptable	Good	Score	comments
Aims and objectives of plans			●	3	
Target audience and updating			●	3	
Details of previous floods		●		2	refer to other plans
Flood hazard map		●		2	
Flood Warning		●		2	
Risk to people		●		2	
Risk to vulnerable people	●			1	
Flood risk to residential properties	●			1	
Flood risk to business	●			1	
Flood risk to critical infrastructure		●		2	
Potential for NaTech hazards	●			3	
Evacuation routes	●			1	
Shelters/Safe havens	●			1	
Relationship with complementary emergency plans			●	3	
Communication with other agencies			●	3	
Communication with the public		●		2	

[3] Specific emergency plan for Loire’s floods

Managment of the media	●			1	
Assumptions made by the plan		●		2	
Plan activation			●	3	
Actions, roles and responsibilities		●		2.5	
Recovery	●			1.5	only advices
Training and exercises	●			1	
			Average	**2.0**	

Figure B6 The location of Brives-Charensac

Review of the PSSIL « plan de secours spécialisé inondation Loire »

Name of plan	Plan de Secours Spécialisé Inondations Loire (P.S.S.I.L)
Name of geographical area covered by the plan:	5 communes of the Le-Puy-en-Velay urban area (Chadrac, Chaspinhac, Coubon, Le Monteil et Brives-Charensac).
Date when the plan was produced:	April, 2009 (latest version). (first version 04/2004)
Approximate area covered by the plan:	5 municipalities = 48,74 km² : - Brives-Charensac : 4,87 km² - Chadrac : 2,48 km² - Chaspinhac : 16,44 km² - Coubon : 22,73 km² - Le Monteil : 2,22 km²
Approximate number of people living in the area covered by the plan.	5 municipalities = 11 363 inhabitants: - Brives-Charensac : 4 577 (2007) - Chadrac : 2 086 (2007) - Chaspinhac : 710 (2007) - Coubon : 3 400 (2008) - Le Monteil : 590 (2007)
Length of the plan:	23 pages.
Aim of the plan:	To alert stakeholders and population from a rising of Loire River.
Brief comments:	This (short) plan completes the Brives-Charensac PCS.

The PSSIL covers 5 communes prone to Loire flood near the city of Le Puy (department of Haute-Loire, centre of France). It is complementary to the PCS of the communes (see above the example of Brives-Charensac) The PSSIL stretches only to 23 pages but refers many times to the PCS of the communes including Brives-Charensac. It was drawn first in 2004. The version reviewed below is the 2009 version. The plan is triggered by the prefecture (state authority).

Table B8 Review of PSSIL (plan de secours specialise inondation Loire)

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans	●			1
Target audience and updating	●			1
Details of previous floods[1]			●	3
Flood hazard map[1]			●	3
Flood Warning		●		3
Risk to people		●		2
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech			●	3

hazards				
Evacuation routes		•		2
Shelters/Safe havens			•	3
Relationship with complementary emergency plans[2]		•		2
Communication with other agencies		•		2
Communication with the public			•	3
Managment of the media	•			1
Assumptions made by the plan		•		2
Plan activation			•	3
Actions, roles and responsibilities		•		2.5
Recovery	•			1
Training and exercises	•			1
			Average	

Figure B7 Location of the PSSIL

Combined analyse of Brives-Charensac PCS and PSSIL

We calculate the joined score for PSSIL and Brives-Charensac PCS. For each metric, we kept the highest score of either PSSIL or Brives-Charensac PCS. The score of both plan together reaches 2,2. So it shows that sometime the coordination of both plans at different levels (regional and local) enhance the effectiveness of emergency planning.

Average score of Brives-Charensac PCS: 2
Average score of PSSIL: 1.7
Average score of both plan (best score for each metric): 2.2

Review of Nanterre Plan communal de sauvegarde

Name of plan	Plan Communal de Sauvegarde of Nanterre - Outil d'aide à la gestion communale de crises.
Name of geographical area covered by the plan:	Nanterre
Date when the plan was produced:	2007.
Approximate area covered by the plan:	12,2 km².
Approximate number of people living in the area covered by the plan.	86 700 inhabitants More than 3 500 people are prone to flood.
Length of the plan:	104 pages.
Aim of the plan:	Help to manage situations that may threaten people, property and environment that tend to disrupt the normal functioning of the city.
Brief comments:	The municipality is submitted to a PPRI (2004) and two PPI (technological dangers).

Nanterre is a city of 88 875 inhabitants in 2007. It is located in the western part of Paris urban area. Nanterre is prone to the floods of Seine River. The 1910 huge floods are the major reference for flood hazard. The type of flooding of Seine River in this town is slow rising flood. Thus, some metrics are not relevant e.g. the risk of building collapsing.

Many studies has been led to describe the effect of a new flood such as 1910 one. The stakeholders for example EDF (the national electricity supply company in France) made simulations about the impacts of such a flood. The city of Nanterre has used those studies to improve its local emergency plan. In another way, Nanterre is prone to technological risk (burst of seveso plants). Thus, as many PCS, the PCS of Nanterre is a multi risk plan including natural and technological risks. But, the "technological" part and "natural" part of the PCS had been drawn separately. Thus, if the technological risk is clearly addressed, the link between flood and technological risk (contamination or explosion) is not clearly mentioned.

According the table of the metrics below, the note is « average". There is a room for improvement and the authorities are currently working on it. Till now, the organisation (shelters, evacuations plans…) is mostly planned for technological risk but can be used for natural risk such as floods. Some points of flood crisis management have not been addressed yet because they are first tested for technological risk (evacuation for example). Owing to the focusing on the 1910 historical one hundred year return period flooding, the intermediate levels of flooding (30 or 50 years return period) are not really addressed.

Table B9 Review of the PCS of Nanterre according to the metrics

Metric	Room for improvement	Acceptable	Good	Score	Comments
Aims and objectives of plans			●	3	
Target audience and updating		●		2	
Details of previous floods			●	3	
Flood hazard map		●		2	
Flood Warning		●		2	
Risk to people		●		2	
Risk to vulnerable people	●			1	list
Flood risk to residential properties			●	3	risk of building collapsing is not relevant
Flood risk to business	●			1	
Flood risk to critical infrastructure		●		2	
Potential for NaTech hazards	●			1	known but not drawn on maps
Evacuation routes	●			1	for technologic al risk only
Shelters/Safe havens		●		2	List only
Relationship with complementary emergency plans			●	3	
Communication with other agencies			●	3	
Communication with the public			●	3	
Managment of the media		●		2	
Assumptions made by the plan			●	3	
Plan activation		●		2	
Actions, roles and responsibilities		●	●	2.5	
Recovery	●			1	
Training and exercises		●		2	for technologic al risk included in the plan
			Average	**2.1**	

Figure B8 location of Nanterre

Review of the DOZDP Dispositif Orsec zone de défense de Paris (flood part)[4]

Name of plan	Dispositif Orsec inondations zone de défense de Paris
Name of geographical area covered by the plan:	Region Ile de France
Date when the plan was produced:	2006 updated version in 2009
Approximate area covered by the plan:	Region Ile-de-France 12012 km2 (Urban area of Paris gathers 90 % of the population of the region)
Approximate number of people living in the area covered by the plan.	11.6 millions of inhabitants 868,000 people are prone to flood and 1.3 millions affected
Length of the plan:	103 pages.
Aim of the plan:	To Prepare authorities and stakeholders to manage a crisis
Brief comments:	The plan is mainly dedicated to critical infrastructure holders (gas electricity supply companies, railways..) to tell them when and how they can handle a crisis. The reference of crisis are the 1910 floods in the basin of Seine River.

[4] Orsec plan in short

The plan follows « the Plan de secours spécialisé inondations zone de défense de Paris ». This plan had been elaborated in order to give a response in case of a general crisis (health, industrial or natural risk) in the Paris urban area that gathers 10.2 millions of people. We only assessed the part of the plan dedicated to the Seine River and tributaries' flooding. The reference in flood is the one hundred year return period flood of January 1910. IN case of a similar scenario, a study of IAURIF state that 868,000 people would be directly affected by seine flooding in Paris Urban area.

The Orsec looks like an organisation set up rather than a real plan. The aim of this plan is to organise the emergency response so the available documents are not directly dedicated to the population but to the stakeholders. Indeed, the flood warning levels are very detailed according the depth of waters at the Austerlitz Bridge in Paris. The Orsec plan is very detailed on the warning level

Another key question is the territorial scale. The Orsec plan is drawn at regional scale. So the some topics are not relevant at this scale. For example, it is not possible to plan the evacuation of all the people affected by flood in the Paris Urban area. So the problem of evacuation is not really addressed in this version of the plan. The plan focuses its attention on the defence of critical infrastructures such as gas network, subway, drinking water supply, light… The plan helps and asks for the 19 major stakeholders to organise their own response to major crisis.

Nanterre PCS (see above) is an application at local level of this Orsec plan. The warning levels are the same for Nanterre and the whole western part of Paris Urban area. (Austerlitz Bridge located in the centre of Paris city).

Table B10 Review of the DOZDP Dispositif Orsec Paris according to the metrics[5]

Metric	Room for improvement	Acceptable	Good	Score	comments
Aims and objectives of plans		●		2	
Target audience and updating			●	3	
Details of previous floods	●			1	
Flood hazard map		●		2	Maps not detailed for all the levels of flooding
Flood Warning			●	3	
Risk to people		●		2	
Risk to vulnerable people		●		2	
Flood risk to residential properties		●		2	
Flood risk to business		●		2	
Flood risk to critical infrastructure			●	3	Very detailed for each stakeholder
Potential for NaTech hazards		●		2	
Evacuation routes		●		2	
Shelters/Safe havens		●		2	Not relevant
Relationship with complementary emergency plans		●		2	
Communication with other agencies			●	3	
Communication with the public	●			1	
Management of the media		●		1	
Assumptions made by the plan			●	3	
Plan activation			●	3	
Actions, roles and responsibilities			●	3	
Recovery	●			1	
Training and exercises		●		2	
			Average	**2.1**	

[5] Orsec plan in short

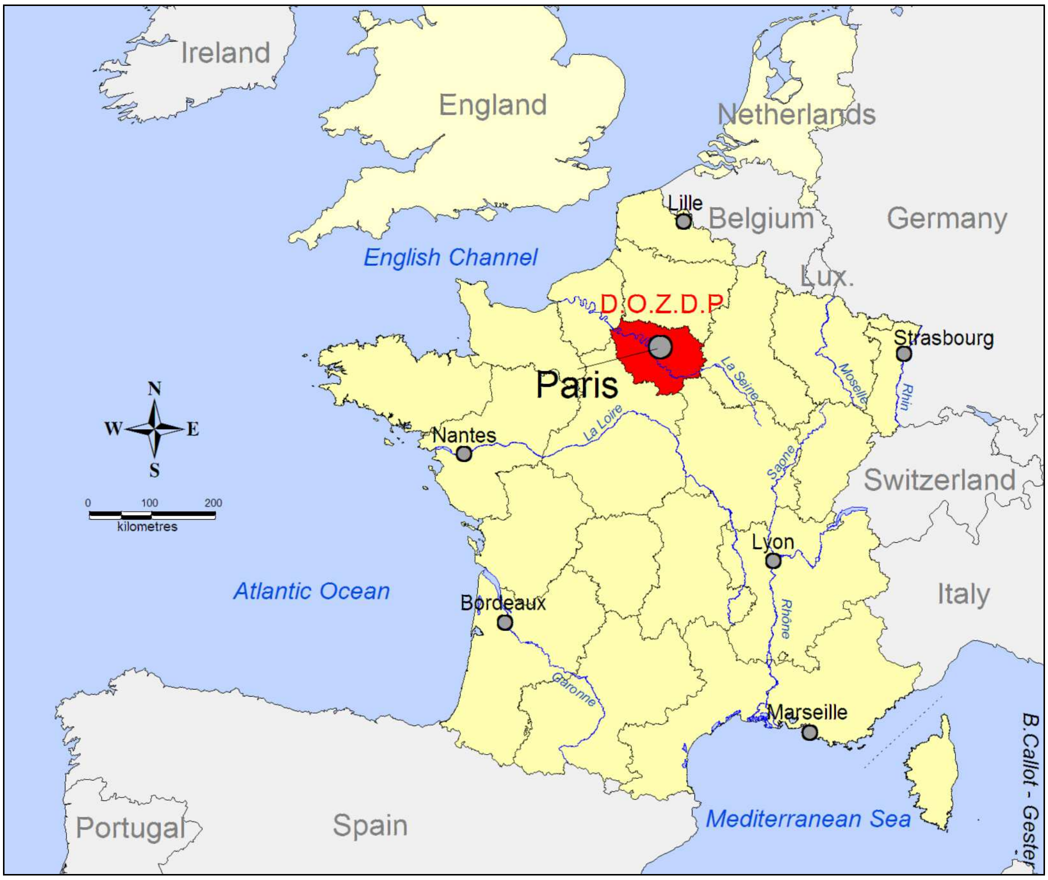

Figure B9 The location of "zone de défense de Paris"

Combined analyses of Nanterre PCS and DOZDParis

If we score the combination of Nanterre PCS and the DOZDP, the score reaches
As for Brives-Charensac and PSSIL reviewed above we calculated the combined scoring of both plans by keep the highest mark for each metric. As for Brives-Charensac and PSSIL, it shows that sometimes, the coordination of both plans at different levels (regional and local) enhance the effectiveness of emergency planning.

- Score of Nanterre PCS: 2
- Score of DOZDParis: 2.1
- Combined score: 2.5

Review of Le Cailar plan communal de sauvegarde

Name of plan	Plan Communal de Sauvegarde of Le-Cailar
Name of geographical area covered by the plan:	The commune of Le Cailar.
Date when the plan was produced:	October, 2007.
Approximate area covered by the plan:	2 369 inhabitants (2006).
Approximate number of people living in the area covered by the plan.	30,01 km².
Length of the plan:	26 pages + appendix.
Aim of the plan:	To inform residents about hazards affecting the commune and to set up measures of prevention and emergency response.
Brief comments:	As the commune is prone to floods from three different rivers; Each river has its own warning system and the procedures to carry out according to the trigger threshold are described for each river too. The synthetic version is rather short but weighty appendix had also been consulted.

2369 inhabitants lived in the commune of Le Cailar in 2006. The commune is located on the French Mediterranean low plains in administrative region of Languedoc-Roussillon. 3 rivers stream across the commune le Vistre, le Rhôny and la Cubelle which is a tributary of Vidourle River. Owing to the very flat topography almost all the territory is prone to flooding. Only the centre of the village is free from floods. Many dikes “protects” the urban area but the design value of dike system is low and dikes use to break. Many houses remain isolated in the low plain when flood occurs.

The commune has been struck by floods in October 1988 (Rhôny River), September 2002 (Vidourle River) and September (Vistre River); thus the PCS is often triggered and the local authorities have a good experience of flood incident management. The worst scenario would be the combination of an extreme discharge of all the rivers at the same time. This scenario is not to be handled by the local authorities. When we asked about that, the authority of the municipally told us that, in any way, handling such an extreme event would overcome the competencies of the commune.
A flood event management plan (non in written version) already existed since 1991. The current PCS in hard copy version was drawn in 2007 (adopted in October 2007) to conform to legal requirement (law of September 2005).

The crisis management is addressed by geographical zone corresponding to different catchments, then by level of risk for which each cell applies the planned “action cards”. According to the metrics the plan was found to be above average (2.2). Indeed, the plan is rather complete. Several sorters give all the details by crisis managers use a synthetic version of the PCS. The global volume of the PCS is more than 500 pages (see photo) and it is sometimes difficult to find the relevant information.

The main shortcoming is the identification and the mapping of elements at risk even if a list registered people at risk. The mapping is not necessary in this condition.

Photo B1 **The whole hard copy version of Le Cailar PCS (Photo taken in the city hall of Le Cailar, F. Vinet)**

A handwriting updating has been made in October 2009 by collecting the phone numbers of new inhabitants. As for the commune of Sommières, training and exercises are not planned owing to the frequency of real floods sometimes several times per year. We score “good” for this metric.

Table B11 Review of le Cailar plan communal de sauvegarde according to the metrics

Metric	●	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating		●		2
Details of previous floods			●	3
Flood hazard map		●		2
Flood Warning			●	3
Risk to people		●		2.5
Risk to vulnerable people	●			1
Flood risk to residential properties			●	3
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards			●	3
Evacuation routes			●	3
Shelters/Safe havens			●	3
Relationship with complementary emergency plans		●		2
Communication with other agencies			●	3
Communication with the public		●		2
Management of the media	●			1
Assumptions made by the plan		●		1.5
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery			●	3
Training and exercises			●	3
			Average	**2.4**

Figure B10 The location of Le Cailar

Review of the Nice plan communal de sauvegarde

Name of plan	Plan communal de sauvegarde Nice
Name of geographical area covered by the plan:	City of Nice.
Date when the plan was produced:	October, 2007.
Approximate area covered by the plan:	71.92 km².
Approximate number of people living in the area covered by the plan.	348,721 inhabitants in 2007
Length of the plan:	?
Aim of the plan:	To prepare the institutional management of a crisis in the city of Nice and to inform the population about risks they are facing to
Brief comments:	Multi risk plan. The plan is made up of 2 parts: Organization of crisis management and the local diagnosis of both risks and vulnerability.

Nice is a city at the very south-eastern part of France (near the Italian border). It is the prefecture of the Alpes-Maritimes department in the region province-Alpes-Cote-d'Azur.
It is the 5th French city with a population of 348, 721 inhabitants in 2007. She is located on the Mediterranean seaside along the “Bay of the Angels”.

The hydrographical network is made with two main rivers submitted to frequent flash floods: the Var River at the western part and the Paillon River embedded under the city in tunnels. Several temporary streams run down from the surrounding hills during severe showers.

The PCS is a “multi risk” one, accessible -as the DICRIM- on the city website where several pages are dedicated to the major risks that Nice City needs to cope with :
The commune is concerned with the following risks:

Natural Risks: floods, landside and subsidence, earthquake, forest fires, extreme weather conditions.
Technological Risks: Transportation of dangerous goods, Seveso industrial plants, littoral pollution.

The consulted document (and evaluated) has been published in 2 parts:

- Version 2 of the 29th of august 2007 for the diagnosis of hazards and vulnerabilities.
- Version 3 of 31 Oct. 2007 for the organization of crisis management.

We were not allowed to read the emergency cards but we know that the rely on two generic plans and seven thematic plans adapted to each risks (forest fire, earthquake…).
According to the metrics, the score is average (2). Contrary to the majority of the plans already assessed, the mapping of hazards and elements at risk is relevant and displayed in a GIS system.

B12 Review of the Nice plan communal de sauvegarde according to the metrics

Metric	Poor	Acceptable	Good	Score
Aims and objectives of plans		•		2.5
Target audience and updating		•		2.5
Details of previous floods		•		2
Flood hazard map			•	3
Flood Warning	•			1
Risk to people			•	3
Risk to vulnerable people			•	3
Flood risk to residential properties			•	3
Flood risk to business			•	3
Flood risk to critical infrastructure			•	3
Potential for NaTech hazards	•			1
Evacuation routes	•			1
Shelters/Safe havens	•			1
Relationship with complementary emergency plans		•		1
Communication with other agencies		•		2
Communication with the public	•			1
Managment of the media	•			1
Assumptions made by the plan	•			1
Plan activation		•		2
Actions, roles and responsibilities		•		2
Recovery	•			1
Training and exercises			•	3
			Average	**2.0**

Figure B11 The location of Nice

Review of the Cléry-Saint-André plan communal de sauvegarde

Name of plan	Modèle de gestion de crise inondation de Cléry-Saint-André (Loiret, 45). (elaborated with the software OSIRIS-Inondation v1.4).
Name of geographical area covered by the plan:	Cléry-Saint-André
Date when the plan was produced:	Updated October, 2009.
Approximate area covered by the plan:	18,13 km².
Approximate number of people living in the area covered by the plan.	3 005 Inhabitants (2006). 494 inhabitants within flood zone.
Length of the plan:	613 pages.
Aim of the plan:	To model a the preparedness and the management of a crisis in a « standard » commune
Brief comments:	The plan is quite exhaustive (elements at risk, numerous maps) One of the first PCS built with the software OSIRIS. Quite a prototype.

The commune of Cléry-St-André, is a small commune of 2789 inhabitants on left bank of the Loire at 16 km from the main town Orleans. The village is situated at 3km far from the River Loire in a flat plain crossed by the little river Ardoux. A levee, built in the 12th century, is supposed to protect the village

against the Loire overflowing. A spillage channel had been built through the levees after the 1856 and 1866 floods that triggered a general failure of dike system in the Loire valley. Even if the commune is prone to many other dangers such as transportation of dangerous goods, storms, land subsidence, the floods of the Loire River are the major risk the commune has to face up.
Since 1907, the commune didn't have to undergo any huge flood. That explain why the risk awareness has weakened in the population (Rode, 2009). The last flood occurred in December 2003 but without major damage. The scenario of crisis takes into account a slow-rising flood of Loire worsened by dike failure. The consequences would be huge water depths (till 5 meters) and a long immersion (several days).

The PCS is mainly based on flood risk, but some other risks previously mentioned are addressed. The last version (assessed) was updated in October 2009. The whole document stretches to 613 pages. It has been drawn thanks to the software Osiris (see description of tools). The plan has been elaborated as a model and took advantage of grants to develop the software OSIRIS. Thus, the plan is currently mentioned as an example. It contains many maps of risk to people, risk to properties and main assets. The maps for the management of the crisis are also very accurate.

The commune is divided in different sectors for which all the information necessary for the management of the crisis is described. It could be called the "rolls Royce" of local emergency plans. According to the metrics, the plan is scored 2.4 (above average). This is the best score we met in assessing the sample of plans. In theory, in hard copy and numerical version, the plan of Cléry-Saint-André is very complete and few shortcomings come out. However, we can wonder if the plan would be "operational" in time of crisis. The only reservation is the transmission of know-how and skills acquired during the setting up of this plan. There is little information about the updating of the plan.

Table B13 Review of Cléry-Saint-André plan communal de sauvegarde according to the metrics

Metric	Poor	Acceptable	Good	Score
Aims and objectives of plans	poor			1
Target audience and updating		acceptable		2
Details of previous floods			good	3
Flood hazard map			good	3
Flood Warning			good	3
Risk to people			good	3
Risk to vulnerable people			good	3
Flood risk to residential properties			good	3
Flood risk to business			good	3
Flood risk to critical infrastructure			good	3
Potential for NaTech hazards			good	3
Evacuation routes			good	3
Shelters/Safe havens			good	3
Relationship with complementary emergency plans	poor			1
Communication with other agencies			good	3
Communication with the public			good	3
Managment of the media	poor			1
Assumptions made by the plan	poor			1
Plan activation			good	3

Actions, roles and responsibilities			good	3
Recovery	poor			1
Training and exercises	poor			1
			average	**2.4**

Figure B11 The location of Cléry-Saint-André

Review of Sommières plan communal de sauvegarde

Name of plan	Modèle de gestion de crise inondation de Cléry-Saint-André (Loiret, 45). (elaborated with the software OSIRIS-Inondation v1.4).
Name of geographical area covered by the plan:	Cléry-Saint-André
Date when the plan was produced:	Updated October, 2009.
Approximate area covered by the plan:	18,13 km².
Approximate number of people living in the area covered by the plan.	3 005 Inhabitants (2006). 494 inhabitants within flood zone.
Length of the plan:	613 pages.
Aim of the plan:	To model a the preparedness and the management of a crisis in a « standard » commune
Brief comments:	The plan is quite exhaustive (elements at risk,

	numerous maps) One of the first PCS built with the software OSIRIS. Quite a prototype.

Sommières is a small commune in the South of France (4505 Inhabitants in 2006), in the department of Gard, region Languedoc Roussillon. The commune is concerned with the flash overflows of the Vidourle River, a 800 km^2 catchments tributary of the Mediterranean sea.The majority of the commune is strongly exposed to the “vidourlades”, floods recurring of the low points of the city built mainly in the bed of flood of the river. The growing urbanization since the Middle Age increased the elements at risk as the city was built first new the River for economical and military reasons. Till 1990’s many building were set up in the flood zone such as the police station, a school and the fireman station as if the risk we completely ignored. However, huge floods are rather frequent: historical testimonies mention 4 major flooding within last 100 years: 1907, 1933, 1958 and the last one in September 2002.
The PCS is for now only dedicated to floods (updated in April 2009) It is organised according three levels of emergency (yellow, orange, red) depending on the water depth in the street of the communes. A page of the website of the commune is especially dedicated to the Vidourle River.

Action cards and resources forms help to state the different responsibilities in case of emergency. Training and exercises are not considered as necessary owing to the frequency rising of Vidourle River. The first level of alert is launched at least 2 or 3 times a year.
According to the metrics, the PCS of Sommières is « above average » with 2.44. Despite the shortage of mapping of economical assets, flood processes and elements at risk are well known by the authorities. We can actually wonder about the transmission of this knowledge in the future when the team who drew the PCS won’t be in responsibilities anymore.

Table B14 Review of Sommières plan communal de sauvegarde according to the metrics

Metric	●	Acceptable	Good	Score
Aims and objectives of plans	●			1
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning			●	3
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards			●	3
Evacuation routes		●		2
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		
Communication with other agencies			●	3
Communication with the public			●	3
Managment of the media			●	3
Assumptions made by the plan	●			1
Plan activation			●	3
Actions, roles and responsibilities			●	3

Recovery			●	3
Training and exercises			●	3
			Average	**2**

Figure B12 The location of Sommières

Review of the Nancy plan communal de sauvegarde according to the metrics

Name of plan	Plan Communal de Sauvegarde of the city of Nancy.
Name of geographical area covered by the plan:	City of Nancy.
Date when the plan was produced:	May, 2009.
Approximate area covered by the plan:	15,01 km².
Approximate number of people living in the area covered by the plan.	105 349 inhabitants (2007).
Length of the plan:	49 pages.
Aim of the plan:	The aim is to develop the preventive information.
Brief comments:	The document is made of three parts : - The DICRIM (under the form of questions/answers that improve the understanding (more didactic)), - The information to the population in case of

	crisis - The resources of the commune to handle a crisis.

Nancy is a city of the North-Eastern France. It is the prefecture of the department of Meurthe-et-Moselle (Lorraine metropolitan region). The commune had a total population of 105, 349 in 2007. The Town of Nancy is prone to 6 major risks listed in the DICRIM: flood, landslide, dam failure, explosion of grain storage silo, transportation of dangerous goods, risk due to old mines (subsidence).

The commune is located at the bottom of a small valley where runs the River Meurthe which generated floods in 1947 (the highest flood ever known) and in December 1982 and six months after in April and May 1983 April.

The last version of the plan has been released in 2009. The score of this plan according to the metrics is rather low (1.4 i.e. room for improvement). This low score can be explained by the shortage of risk assessment maps (risk to people, risk to economical assets…). The link between technological dangers and natural hazards is not addressed. The plan only refers to a map of shelters and safe heavens. The plan is recent and the municipal authorities are eager to improve some shortcomings.

Table B15 Review of the Nancy plan communal de sauvegarde according to the metrics

Metric	Poor	Acceptable	Good	Score
Aims and objectives of plans		•		2
Target audience and updating		•		2
Details of previous floods		•		2
Flood hazard map		•		2.5
Flood Warning	•			1
Risk to people	•			1
Risk to vulnerable people	•			1
Flood risk to residential properties	•			1
Flood risk to business	•			1
Flood risk to critical infrastructure	•			1
Potential for NaTech hazards	•			1
Evacuation routes	•			1
Shelters/Safe havens		•		2
Relationship with complementary emergency plans	•			1
Communication with other agencies	•			1
Communication with the public		•		2
Managment of the media		•		2
Assumptions made by the plan	•			1
Plan activation	•			1
Actions, roles and responsibilities		•		2
Recovery	•			1
Training and exercises	•			1

			Average	**1.4**

Figure B13 The location of Nancy

Review of the Saint-Raphael plan communal de sauvegarde

Name of plan	Plan Communal de Sauvegarde - Manuel opérationnel et information du public.
Name of geographical area covered by the plan:	City of Saint-Raphaël.
Date when the plan was produced:	2009.
Approximate area covered by the plan:	89,59 km².
Approximate number of people living in the area covered by the plan.	34 425 inhabitants (01/01/2009) but up to 92 500 people in summer (tourists)
Length of the plan:	142 pages.
Aim of the plan:	Give information to people and set up the operational organization.
Brief comments:	It is composed of three parts: Section description, section operational and section information (DICRIM). PCS takes into account the touristic activity (that is very important in this case). Different hazards are detailed in specific sheets.

Saint-Raphael is a Commune of the department Var in Mediterranean southern part of France and had an estimated population of 34, 425 habitants (January 2009). The city can be exposed to several technological and natural dangers such as forest fire, earthquake, landslide, bad weather conditions and dam failure, sea contamination and transportation of dangerous goods. Concerning flood risk the communes is proneto the overflowing of small catchments (Garonne, Agay…) and by pluvial runoff. The hydrological response is very quick after intense rainfalls in autumn.
The PCS that we assessed is dated 2009 and available on line with the DICRIM. The document refers to a previous « flood emergency plan in the commune" without giving more details. The PCS of Saint-Raphaël is drawn as an operational handbook organised by hazards with links to actions to implement for each hazard.

The plan is badly scored according to the metrics (1.5) i.e. « room for improvement ». The « bad » score of the plan can be explained by the shortage of maps. Only two maps (bad quality) shows the flood prone zone and flood to public buildings. The catchments prone to floods neither are mentioned in the DICRIM. We remind that the DICRIM is a document actually included in the PCS and which deals with the information to the population on major risks existing in the commune.

Table B16 Review of the Saint-Raphaël plan communal de sauvegarde according to the metrics

Metric	Poor	Acceptable	Good	Score
Aims and objectives of plans	•			1
Target audience and updating		•		2
Details of previous floods	•			1
Flood hazard map		•		2
Flood Warning	•			1
Risk to people	•			1
Risk to vulnerable people	•			1
Flood risk to residential properties	•			1
Flood risk to business	•			1
Flood risk to critical infrastructure	•			1
Potential for NaTech hazards	•			1
Evacuation routes	•			1
Shelters/Safe havens	•			
Relationship with complementary emergency plans			•	3
Communication with other agencies			•	3
Communication with the public		•		2
Managment of the media		•		2
Assumptions made by the plan	•			1
Plan activation		•		2
Actions, roles and responsibilities		•		2
Recovery	•			1.5
Training and exercises	•			1.5
			Average	**1.5**

Figure B14 The location of Saint-Raphael

Review of Piolenc plan communal de sauvegarde

Name of plan	Plan Communal of Piolenc.
Name of geographical area covered by the plan:	City of Piolenc.
Date when the plan was produced:	April, 2009.
Approximate area covered by the plan:	24.8 km².
Approximate number of people living in the area covered by the plan.	4 495 inhabitants in 2006.
Length of the plan:	122 pages.
Aim of the plan:	This plan aims to define the first steps to implement by the mayor, in order to protect people and property, and in waiting the triggering of the departmental plan.
Brief comments:	This is a multi-risk plan. The plan seems to have been quickly drawn up. Many cards and sheets are directly extracted from national guidelines. Several mistakes appear such as PSC instead of PCS p.13. The plan is redundant: the warning plan comes out three times (16, 27, 28). Moreover, these repetitions are not in similar terms. It is the same for the safety instructions that appear several

	times without being the same. Several pages are dedicated to H1N1 influenza.

The commune of Piolenc is situated in the southern France in the department of “Vaucluse” in the region “provence Alpes-Côte-d’Azur”. 4495 inhabitants lived in the communes in 2006. The commune is prone to the flood of Rhone River and the floods of Aygues River. The Rhone River floods are slow rising flood but they spread over a large low plain and can trigger many damages especially on industrial and nuclear plants. The Aygues and Rieu du Foyro rivers run down from the surrounding hills and trigger flash floods in autumn (September to December).

What arises from the PCS of Piolenc is that it seems to have been made in urgency in April 2009. Most of the sheets compiled in the PCS are copies (“copy and paste”) of generic files stated in different guidelines by states services (ministry, prefecture). The average note is rather low because even if the PCS stretches to 122 p., few of them concerns flood risk. Many risks are addressed: technological and nuclear risk including influenza epidemic. We suppose that the commune was compelled to respect legal demand and drew a first draft.

Table B17 Review of the PCS of Piolenc according the metrics

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans	●			1
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map		●		2.5
Flood Warning	●			1
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards			●	3
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies	●			1
Communication with the public		●		2
Managment of the media	●			1
Assumptions made by the plan		●		2
Plan activation	●			1
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises	●			1
			Average	**1.4**

Figure B15 The location of Piolenc

Appendix C Details of the review of Multi-Agency Floodplains in the Netherlands

Introduction
A few Safety Regions were unwilling to hand over their plan due to the fact that these plans were too much of a draft version to be handed over to a third party. Eleven regions provided draft plans that were of high enough quality to be used in this research. To protect the privacy of the participating regions, it was decided to compare the plans anonymously. The names of the plans are therefore replaced by numbers. Table C1 provides brief details of the plans that were available to the project by the end of January 2010 and that were analysed using the developed metrics.

The following assumptions were made when using the metrics in the Netherlands:

- If a metric was qualified in between for instance poor and acceptable, it was qualified as poor;
- If a metric was not mentioned at all in the plan, it was qualified as poor;
- A detailed scenario analysis was assumed to be covered by the metric 'Aims and objectives of the plan';
- If for a certain metric the plan referred to another plan or document, the metric was qualified as acceptable.

Table C1 List of flood emergency plans reviewed for the Netherlands

Name of plan	Type of plan	Date of plan	Length of plan (pages)	Score
Plan 1	Safety Region plan	Version 1.0, 5th of June 2007	286	2.3
Plan 2	Safety Region plan	March 26, 2009	76	1.8
Plan 3	Safety Region plan	May 2009	109	1.6
Plan 4	Safety Region plan	Version 1.0, 3rd of December 2008	88	2.2
Plan 5	Safety Region plan	Version 3.0, November 2009 (draft)	54	1.7
Plan 6	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	15th of September, 2005	188	1.8
Plan 7	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	Version 1.1, 14th of August, 2007	41	1.2
Plan 8	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	Version 2, 1st of October 2007	31	1.5
Plan 9	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	Version 2.3, December 2009 (draft)	36	1.4
Plan 10	Regional plan constructed by multiple parties (municipalities, Water Boards, etc.)	August 2008 (draft)	55	1.6
Plan 11	Safety Region plan	Februari 2010 (draft)	57	1.6
National response plan	National Response Plan	August 2008	157	1.6

Review of Plan 1
This plan focuses on disaster caused by river floods. The area covered by this plan includes several larger cities, in the order of magnitude of several hundreds of thousands each. Also, the area has a high economical value. The plan was produced in June 2007. It is 286 pages in length and generally quite specific. It could improve on information about flood risk, recovery, and details of previous floods. Most metrics scored high however, resulting in a score well above average. A lay-out was used that is used by some other official plans.

Table C2 Review of Plan 1

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning			●	3
Risk to people			●	3
Risk to vulnerable people		●		2
Flood risk to residential properties	●			1
Flood risk to business			●	3
Flood risk to critical infrastructure			●	3
Potential for NaTech hazards		●		2
Evacuation routes			●	3
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan		●		2
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery	●			1
Training and exercises		●		2
			Average score	2.3
			Rating	"Above average"

Review of Plan 2

This plan focuses on disaster caused by lake floods. The area covered by this plan includes several smaller cities (below 100,000 inhabitants), but is not very large. The plan was produced in March 2009. It is 76 pages in length and generally not very specific, but acceptable. A lay-out was used that is used by some other official plans. The plan could be improved on details of most metrics. One way in which the plan could be improved is by the addition of additional maps and figures at a suitable scale.

Table C3 Review of Plan 2

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning		●		2
Risk to people		●		2
Risk to vulnerable people	●			1
Flood risk to residential properties		●		2
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards		●		2
Evacuation routes		●		2
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan		●		2
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises		●		2
			Average score	1.8
			Rating	“Below average”

Review of Plan 3

This plan focuses on disaster caused by sea and lake floods. The area covered by this plan includes some cities (below and above 100,000 inhabitants), and is quite large. However, it should be noted that in general, this region is not very densely populated. Also, we know that it is probably assumed that most cities in this region are not very likely to flood. The plan was produced in May 2009. It is 109 pages in length and generally not very specific. Risks are usually not specified, and evacuation routes and shelters are not defined. Also recovery is not mentioned in detail. This results in a score below average. The plan could be improved on most metrics. One way in which this could be done is by the addition of more detailed information, maps and figures at a suitable scale.

Table C4 Review of Plan 3

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning	●			1
Risk to people		●		2
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans	●			1
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media	●			1
Assumptions made by the plan			●	3
Plan activation			●	3
Actions, roles and responsibilities			●	3
Recovery	●			1
Training and exercises	●			1
			Average score	1.6
			Rating	"Below average"

Review of Plan 4
This plan focuses on disaster caused by river floods. The area covered by this plan includes a considerable number of cities (below and above 100,000 inhabitants), and is quite large. The plan was produced in December 2008. It is 88 pages in length and generally quite specific, resulting in an above average score. A lay-out was used that is used by some other official plans. The plan could be improved on some metrics. One way in which this could be done is by a better definition of risk, a better defined relationship with other plans and on details of previous floods.

Table C5 Review of Plan 4

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating			●	3
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning		●		2
Risk to people			●	3
Risk to vulnerable people		●		2
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure			●	3
Potential for NaTech hazards		●		2
Evacuation routes			●	3
Shelters/Safe havens		●		2
Relationship with complementary emergency plans	●			1
Communication with other agencies			●	3
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan			●	3
Plan activation			●	3
Actions, roles and responsibilities		●		2
Recovery		●		2
Training and exercises		●		2
			Average score	2.2
			Rating	“Above average”

Review of Plan 5
This plan focuses on disaster caused by river and sea floods. The area covered by this plan includes a considerable number of cities (below and above 100,000 inhabitants), and is quite large. The plan was produced in November 2009, and it is a draft version. This fact should be taken into consideration when looking at its score. It is 54 pages in length and generally not very specific, resulting in a score below average. The plan could be improved on many metrics. One way in which this could be done is by defining risk better. Also, the plan could be improved by adding maps and figures at a suitable scale.

Table C6 Review of Plan 5

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning		●		2
Risk to people		●		2
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public			●	3
Management of the media		●		2
Assumptions made by the plan		●		2
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises		●		2
			Average score	1.7
			Rating	"Below average"

Review of Plan 6

This plan focuses on disaster caused by sea floods. The area covered by this plan includes a number of cities (below and above 100,000 inhabitants), and is quite large. However, quite some parts of the region are not very densely populated. Also, we know that it is probably assumed that most parts of this region are not very likely to flood. The plan was produced in September 2005, and it is not sure if this plan is an official safety region document. It includes the plans of several sub-regions, and in total the plan is 188 pages in length. The plan is generally not very specific, with many references to information to be found in other plans. This results in a score below (but close to) average. The plan could be improved on many metrics, basically by providing more detail in the plan itself. This could be done by adding maps and figures at a suitable scale.

Table C7 Review of Plan 6

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating	●			1
Details of previous floods	●			1
Flood hazard map		●		2
Flood Warning		●		2
Risk to people		●		2
Risk to vulnerable people		●		2
Flood risk to residential properties		●		2
Flood risk to business	●			1
Flood risk to critical infrastructure		●		2
Potential for NaTech hazards		●		2
Evacuation routes		●		2
Shelters/Safe havens		●		2
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises	●			1
			Average score	1.8
			Rating	"Below average"

Review of Plan 7

This plan focuses on disaster caused by sea floods. The area covered by this plan includes a number of cities (below and above 100,000 inhabitants), and is quite large. The plan was produced in August 2007, and it is a regional plan constructed by multiple parties (municipalities, waterboards, etc.). The plan is 41 pages in length. The plan is generally not specific at all. This results in a low score, close to 1. The plan could be improved on almost every metric, basically by providing more detail in the plan itself. This could be done by adding maps and figures at a suitable scale and defining risk better.

Table C8 Review of Plan 7

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating	●			1
Details of previous floods	●			1
Flood hazard map	●			1
Flood Warning		●		2
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans	●			1
Communication with other agencies	●			1
Communication with the public		●		2
Management of the media	●			1
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises	●			1
			Average score	1.2
			Rating	“Below average”

Review of Plan 8

This plan focuses on disaster caused by river floods. The area covered by this plan includes a number of cities (below and above 100,000 inhabitants), but is not very densely populated. The plan was produced in October 2007, and it is a regional plan constructed by multiple parties (municipalities, waterboards, etc.). The plan is 31 pages in length. The plan is generally not specific, which results in a score below average. The plan could be improved on almost every metric, basically by providing more detail in the plan. This could be done by adding maps and figures at a suitable scale, by defining risk better and by providing more detail on recovery.

Table C9 Review of Plan 8

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map	●			1
Flood Warning		●		2
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans	●			1
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises		●		2
			Average score	1.5
			Rating	"Below average"

Review of Plan 9

This plan focuses on disaster caused by river floods. The area covered by this plan includes a number of cities (below and above 100,000 inhabitants), but is not very densely populated. The plan (which is a draft version) was produced in December 2009, and it is a regional plan constructed by multiple parties (municipalities, Water Boards, etc.). The plan is 36 pages in length. The plan is generally not specific, which results in a score below average. The plan could be improved on almost every metric, basically by providing more detail in the plan. This could be done by adding maps and figures at a suitable scale, by defining risk better and by providing more detail on recovery.

Table C10 Review of Plan 9

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans	●			1
Target audience and updating	●			1
Details of previous floods		●		2
Flood hazard map	●			1
Flood Warning		●		2
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans	●			1
Communication with other agencies				
Communication with the public		●		2
Management of the media		●		2
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises		●		2
			Average score	1.4
			Rating	“Below average”

Review of Plan 10

This plan focuses on disaster caused by sea floods. The area covered by this plan is not very densely populated, but includes some cities. The plan (which is a draft version) was produced in August 2008, and it is a regional plan constructed by multiple parties (municipalities, waterboards, etc.). The plan is 55 pages in length. The plan is generally not very specific, which results in a score below average. The plan could be improved by providing more detail in the plan. This could be done by adding maps and figures at a suitable scale, by defining risk better and by providing more detail on training and recovery.

Table C11 Review of Plan 10

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning		●		2
Risk to people		●		2
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes		●		2
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies		●		2
Communication with the public		●		2
Management of the media	●			1
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises	●			1
			Average score	1.6
			Rating	"Below average"

Review of Plan 11

This plan focuses on disaster caused by sea and river floods. The area covered by this plan is very densely populated, and includes some large cities. The plan (which is a draft version) was produced in February 2010, and it is a safety region plan. The plan is 57 pages in length. The plan is generally not very specific, which results in a score below average. The plan could be improved by providing more detail. This could be done by adding maps and figures at a suitable scale, by defining risk better and by providing more detail on training and recovery.

Table C12 Review of Plan 11

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans			●	3
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map			●	3
Flood Warning	●			1
Risk to people		●		2
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes			●	3
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies			●	3
Communication with the public		●		2
Management of the media	●			1
Assumptions made by the plan	●			1
Plan activation		●		2
Actions, roles and responsibilities		●		2
Recovery	●			1
Training and exercises	●			1
			Average score	1.6
			Rating	"Below average"

Review of National Response Plan
The national plan does not score very high. This is mainly caused by the fact that this plan focuses on the organization, responsibilities, duties and authorities of the different institutes and officials. As can be seen in the table, the scores for metrics concerning these topics are quite high. It is reasonable that this plan does not include all different flood hazards or all safe havens present in the whole country. This level of preparedness is the responsibility of the safety regions.

Table C13 Review of National Plan

Metric	Room for improvement	Acceptable	Good	Score
Aims and objectives of plans		●		2
Target audience and updating		●		2
Details of previous floods	●			1
Flood hazard map	●			1
Flood Warning	●			1
Risk to people	●			1
Risk to vulnerable people	●			1
Flood risk to residential properties	●			1
Flood risk to business	●			1
Flood risk to critical infrastructure	●			1
Potential for NaTech hazards	●			1
Evacuation routes	●			1
Shelters/Safe havens	●			1
Relationship with complementary emergency plans		●		2
Communication with other agencies			●	3
Communication with the public			●	3
Management of the media		●		2
Assumptions made by the plan		●		2
Plan activation		●		2
Actions, roles and responsibilities			●	3
Recovery	●			1
Training and exercises	●			1
			Average score	1.6
			Rating	“Below average”

Appendix D Independent validation of metrics

Introduction
England and Wales

Two plans were reviewed independently for England and Wales. These were:

Cumbria Multi-Agency Flood Plan
Suffolk Multi Agency Flood Plan

The results of the exercise are summarized in Table D1.

Table D1 Summary of independent review of plans using metrics in England and Wales

Name of plan	Original average score	Independent reviewer average score	Difference in metric scores between reviewer and original		
			Higher scores	Lower scores	Same scores
Cumbria Multi-Agency Flood Plan	2.2	1.9	1	9	12
Suffolk Multi Agency Flood Plan	1.5	1.7	6	0	16

The original average review for the Cumbria MAFP was 2.25 which meant it just fell into the "Good" category. Using the independent reviewer average score it would be reclassified as an "Average" plan. The Suffolk MAFP was classified as a plan with "Room for improvement" using the independent reviewer's score this remains the case, albeit that the average plan score given by the reviewer was 1.7 compared to 1.5.

France

Two plans were reviewed independently for France. These were:

- Piolenc PCS
- Quissac PCS

The results of the exercise are summarized in Table D2.

Table D2 Summary of independent review of plans using the metrics in France

Name of plan	Original average score	Independent reviewer average score	Difference in metric scores between reviewer and original		
			Higher scores	Lower scores	Same scores
Piolenc PCS	1.4	1.4	4	6	12
Quissac PCS	2.2	2.4	7	2	13

The original average review for the Quissac PCS was 2.20 which meant it just fell into the “Good” category. Using the independent reviewer average score of 2.4 it would still be classified as “Good”. The Piolenc PCS was classified as a plan with “Room for improvement” using the reviewer score this remains the case.

D3 The Netherlands

Two plans were reviewed. These were:

- Plan 4
- Plan 9

The results of the exercise are summarized in Table D3.

Table D3 Summary of independent review of plans using the metrics in France

Name of plan	Original average score	Independent reviewer average score	Difference in metric scores between reviewer and original		
			Higher scores	Lower scores	Same scores
Plan 4	2.3	2.3	3	3	16
Plan 9	1.3	1.5	4	2	16

The original average review for Plan 4 was 2.33 which meant it fell into the “Above average” category. The independent reviewer scored the same value, although the metrics were not all scored similar. Plan 9 was classified as a plan with “Considerable room for improvement”. The reviewer scored a 1.50 which is classes as “Room for improvement”.

Appendix E Online survey carried out in England and Wales

Exit Survey »

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Hello

This brief survey has been put together to inform a research project called Flood Incident Management a FRAMEwork for improvement (FIM FRAME) www.fimframe.net. *The survey is aimed at members of Local Resilience Forums, including Environment Agency staff, that are involved in developing and using Multi-Agency Flood plans.*

FIM FRAME is part of the ERA-NET CRUE research programme (www.crue-eranet.net) that is partly funded by Defra/The Environment Agency. The CRUE network has been set up to consolidate existing European flood research programmes, promote best practice and identify gaps and opportunities for collaboration on future programme content. Its 16 partners, of which the Environment Agency is one, come from most European countries that have been particularly badly affected by flooding.

The project is being led by HR Wallingford (England & Wales) in partnership with Deltares (The Netherlands), Gestion des Sociétés, des Territoires et des Risques (GESTER), Université of Montpellier III (France) and Laboratoire Central des Ponts et Chausées (France).

The objectives of the project are:

(i) To assess the effectiveness and robustness of current flood event management plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved
(ii) To evaluate the current tools that are used for flood event management planning and the ability of these tools to support the management of future flood emergencies
(iii) To establish how currently available tools can be used to improve emergency management plans for floods and whether there are any gaps in the available tools
(iv) To provide a framework by which flood incident management can be improved that will be tested in a case studies in France, The Netherlands and the UK

The main objectives of the survey are:

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(i) To assess the effectiveness and robustness of current flood event management plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved
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(iii) To establish how currently available tools can be used to improve emergency management plans for floods and whether there are any gaps in the available tools
(iv) To provide a framework by which flood incident management can be improved that will be tested in a case studies in France, The Netherlands and the UK

The main objectives of the survey are:

(i) To understand what information is of assistance to emergency planners in assisting them with the formulation of Multi Agency Flood Plans
(ii) To understand what tools (e.g. methods, guidelines, software etc), if any, could be developed to assist with the development of Multi Agency Flood Plans

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact Darren Lumbroso by email at d.lumbroso@hrwallingford.co.uk.

It should take no more than 10 minutes to complete the questionnaire.

Thank you very much for your time and support. Please start with the survey now by clicking on the Continue button below.

Continue

Environment Agency CRUE FLOODING ERA-NET HR Wallingford

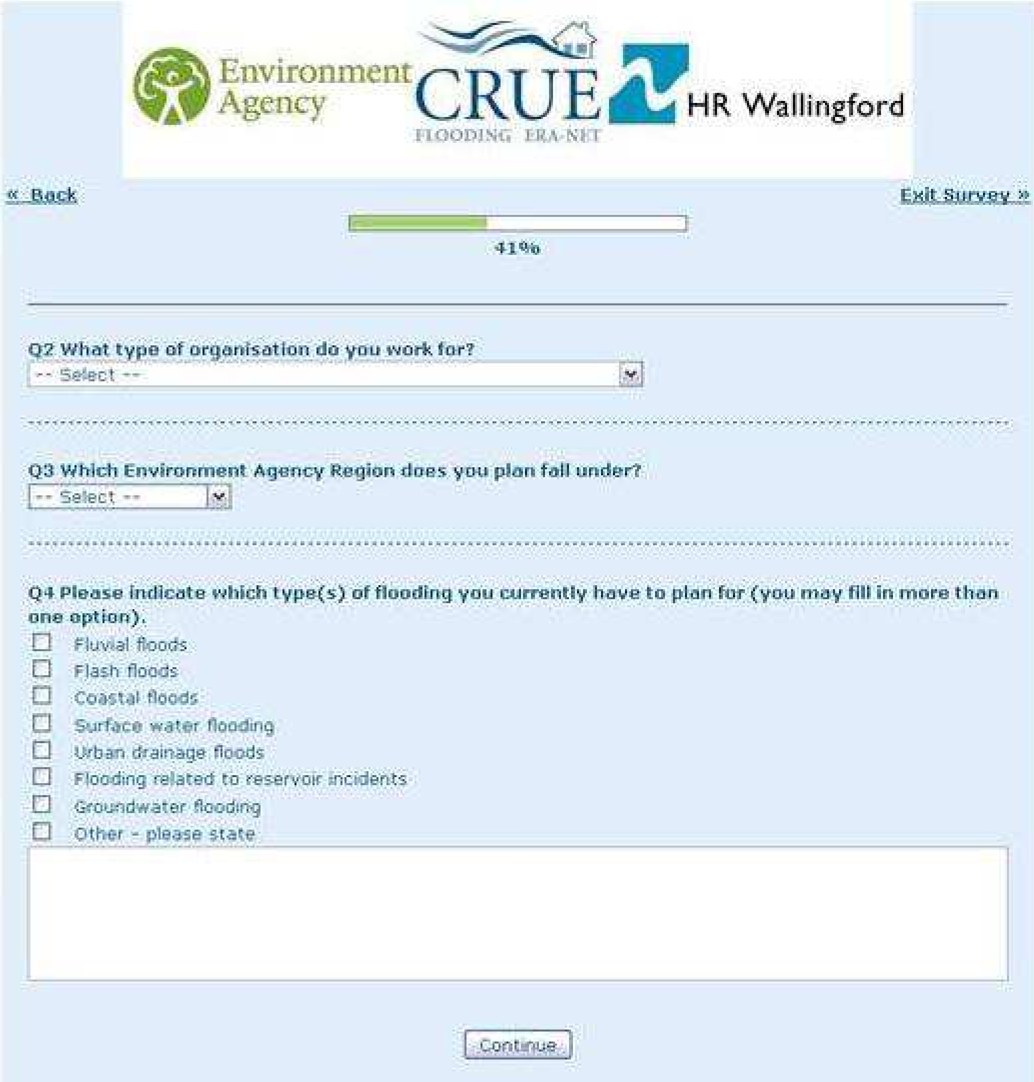
« Back Exit Survey »

16%

Q1 Are you currently responsible or involved with preparing Multi Agency Flood Plans?

- Yes
- No
- Don't know

Continue



Environment Agency CRUE FLOODING ERA-NET HR Wallingford

« Back

Exit Survey »

41%

Q2 What type of organisation do you work for?

-- Select --

Q3 Which Environment Agency Region does you plan fall under?

-- Select --

Q4 Please indicate which type(s) of flooding you currently have to plan for (you may fill in more than one option).

- ☐ Fluvial floods
- ☐ Flash floods
- ☐ Coastal floods
- ☐ Surface water flooding
- ☐ Urban drainage floods
- ☐ Flooding related to reservoir incidents
- ☐ Groundwater flooding
- ☐ Other - please state

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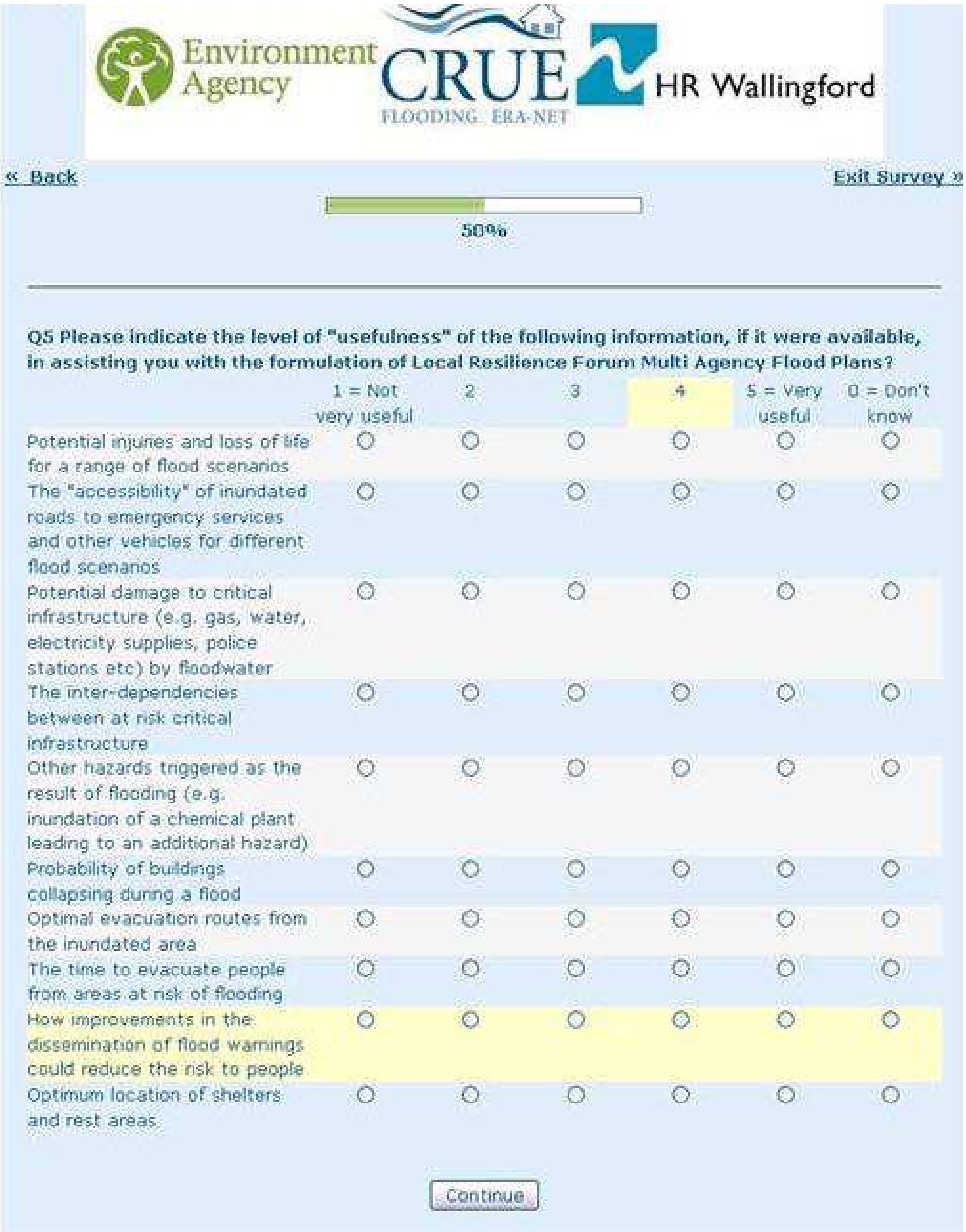


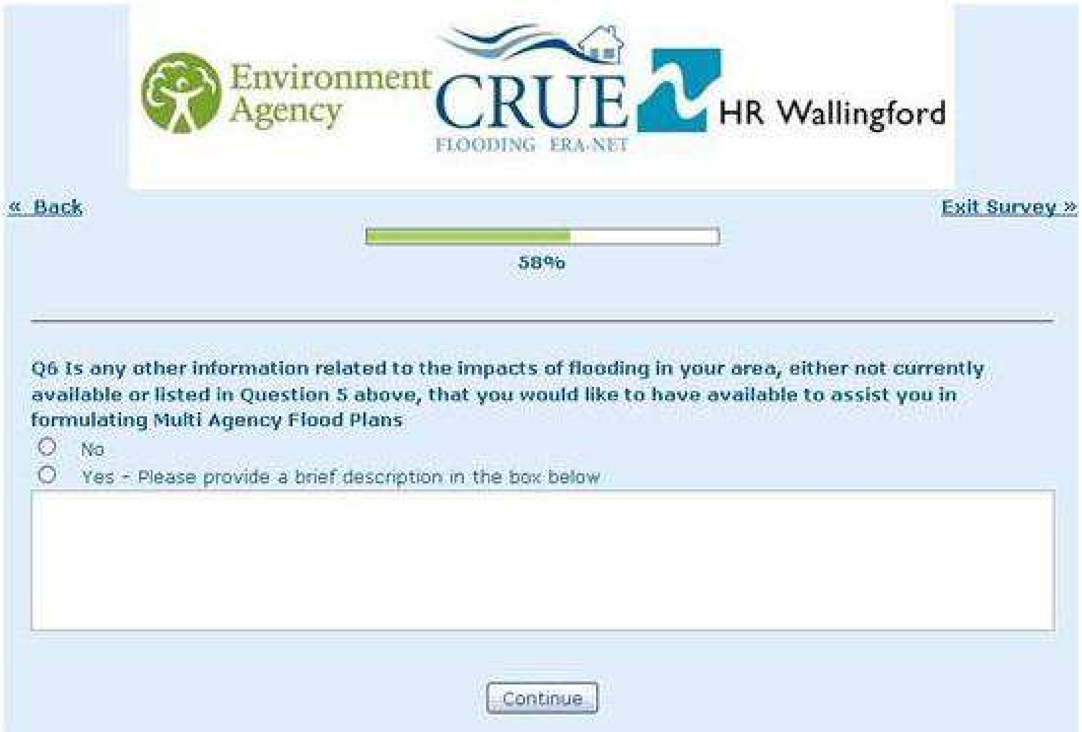
« Back | Exit Survey »

50%

Q5 Please indicate the level of "usefulness" of the following information, if it were available, in assisting you with the formulation of Local Resilience Forum Multi Agency Flood Plans?

	1 = Not very useful	2	3	4	5 = Very useful	0 = Don't know
Potential injuries and loss of life for a range of flood scenarios	○	○	○	○	○	○
The "accessibility" of inundated roads to emergency services and other vehicles for different flood scenarios	○	○	○	○	○	○
Potential damage to critical infrastructure (e.g. gas, water, electricity supplies, police stations etc) by floodwater	○	○	○	○	○	○
The inter-dependencies between at risk critical infrastructure	○	○	○	○	○	○
Other hazards triggered as the result of flooding (e.g. inundation of a chemical plant leading to an additional hazard)	○	○	○	○	○	○
Probability of buildings collapsing during a flood	○	○	○	○	○	○
Optimal evacuation routes from the inundated area	○	○	○	○	○	○
The time to evacuate people from areas at risk of flooding	○	○	○	○	○	○
How improvements in the dissemination of flood warnings could reduce the risk to people	○	○	○	○	○	○
Optimum location of shelters and rest areas	○	○	○	○	○	○

Continue



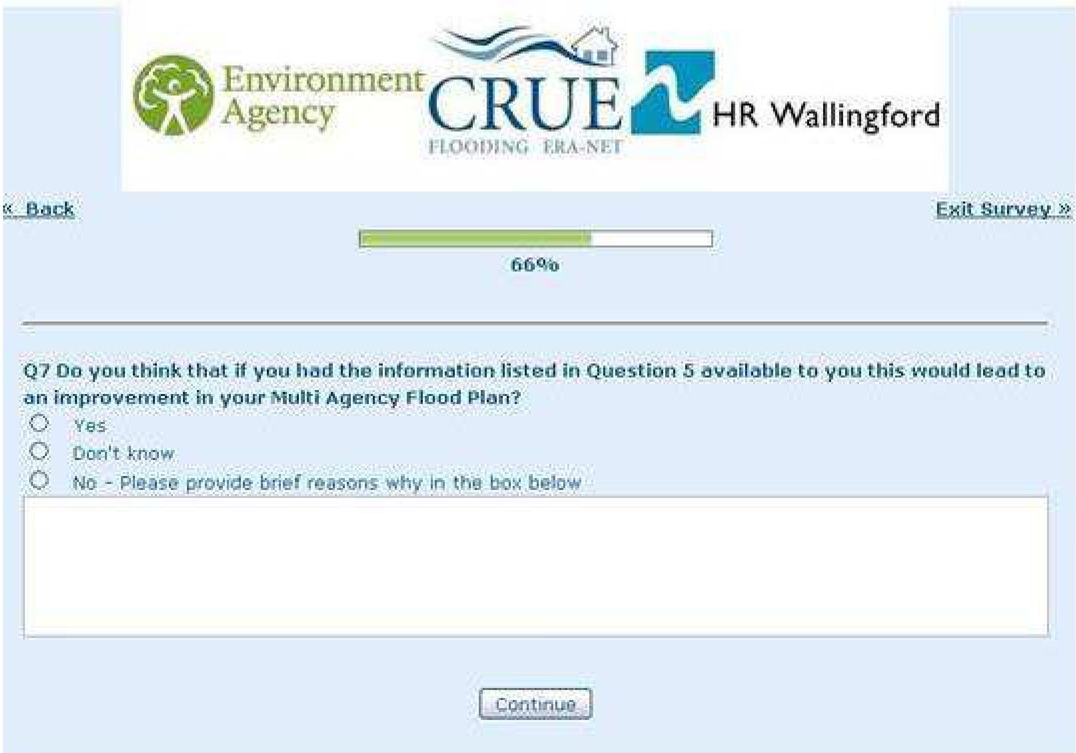
« Back | Exit Survey »

58%

Q6 Is any other information related to the impacts of flooding in your area, either not currently available or listed in Question 5 above, that you would like to have available to assist you in formulating Multi Agency Flood Plans

- No
- Yes - Please provide a brief description in the box below

Continue



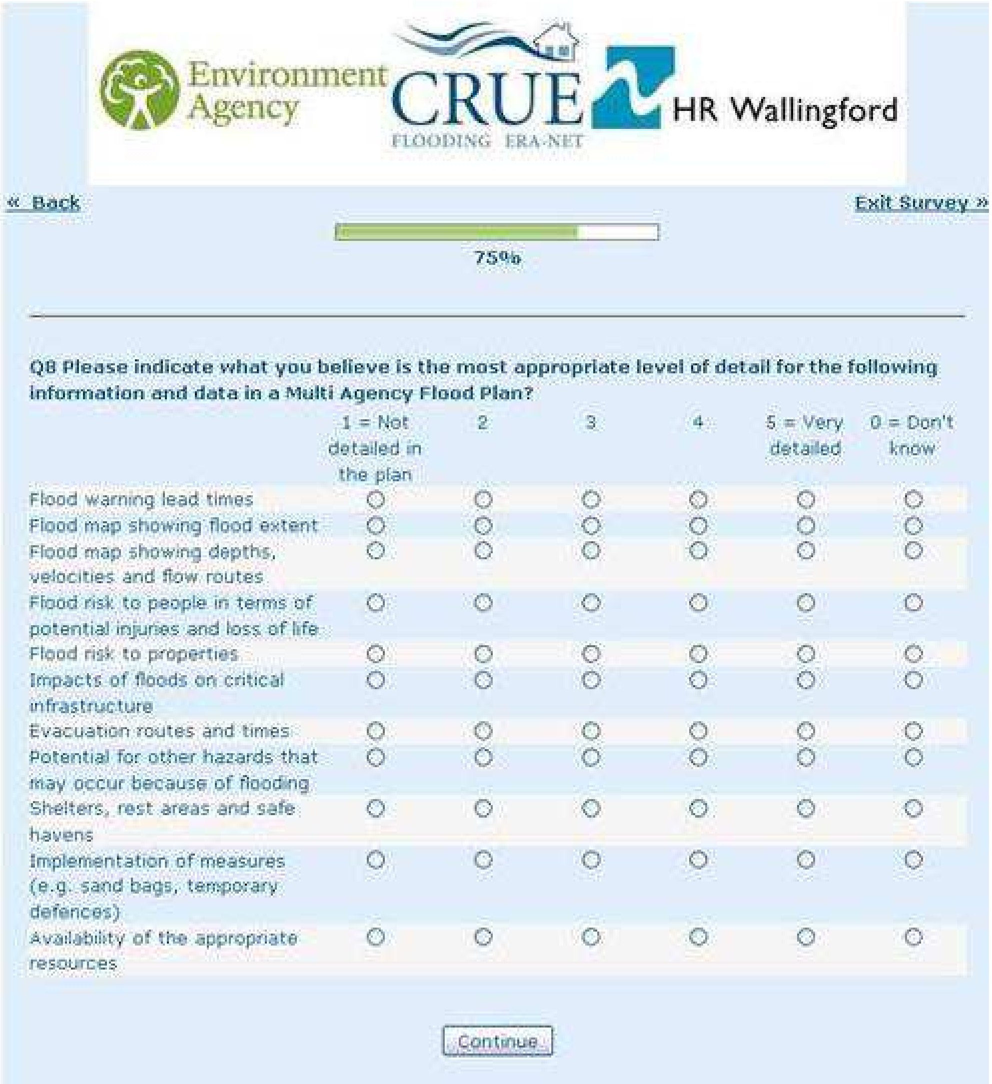
« Back | Exit Survey »

66%

Q7 Do you think that if you had the information listed in Question 5 available to you this would lead to an improvement in your Multi Agency Flood Plan?

- Yes
- Don't know
- No - Please provide brief reasons why in the box below

Continue



« Back

Exit Survey »

75%

Q8 Please indicate what you believe is the most appropriate level of detail for the following information and data in a Multi Agency Flood Plan?

	1 = Not detailed in the plan	2	3	4	5 = Very detailed	0 = Don't know
Flood warning lead times						
Flood map showing flood extent						
Flood map showing depths, velocities and flow routes						
Flood risk to people in terms of potential injuries and loss of life						
Flood risk to properties						
Impacts of floods on critical infrastructure						
Evacuation routes and times						
Potential for other hazards that may occur because of flooding						
Shelters, rest areas and safe havens						
Implementation of measures (e.g. sand bags, temporary defences)						
Availability of the appropriate resources						

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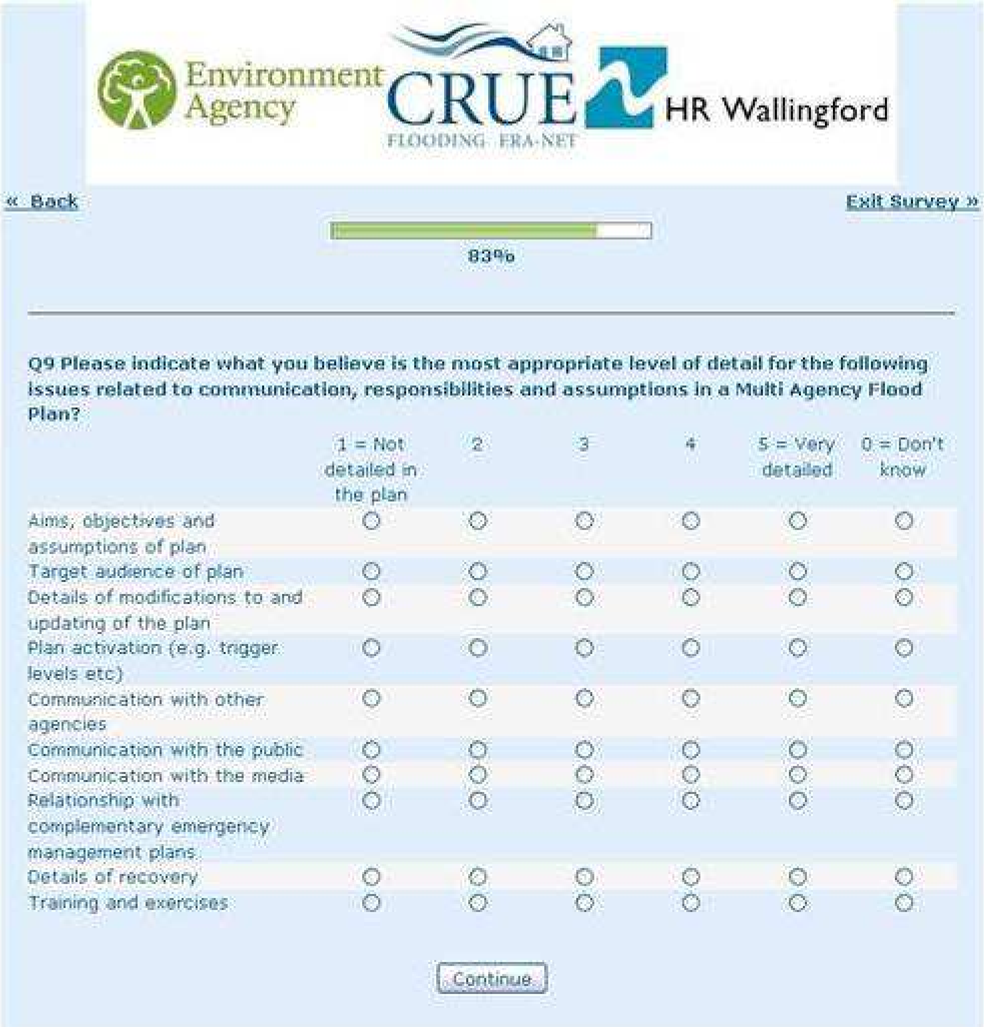


Environment Agency CRUE FLOODING ERA-NET HR Wallingford

« Back

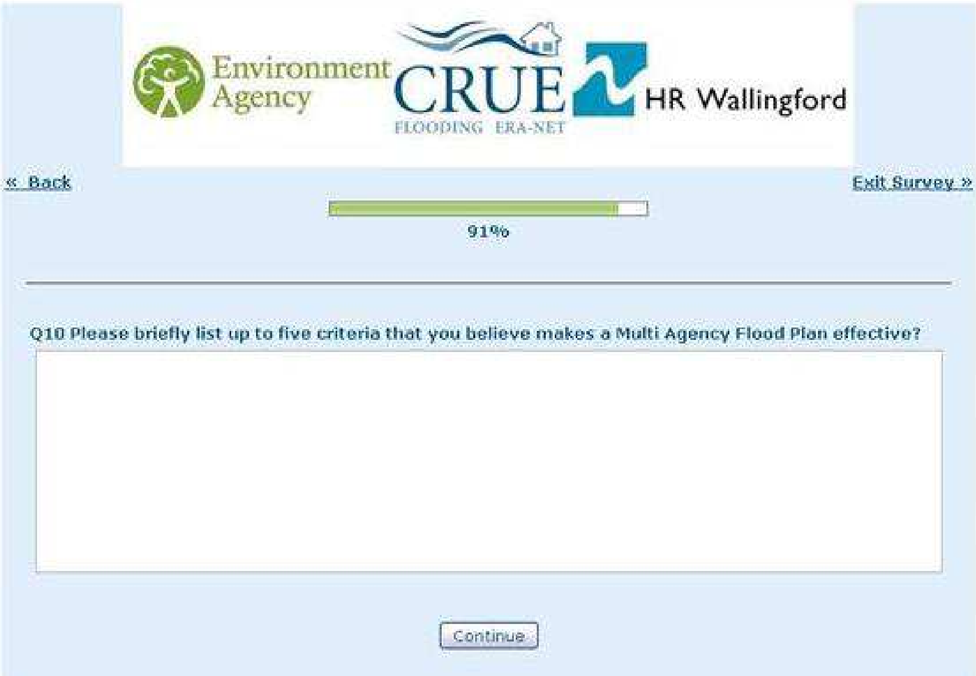
Exit Survey »

83%

Q9 Please indicate what you believe is the most appropriate level of detail for the following issues related to communication, responsibilities and assumptions in a Multi Agency Flood Plan?

	1 = Not detailed in the plan	2	3	4	5 = Very detailed	0 = Don't know
Aims, objectives and assumptions of plan	○	○	○	○	○	○
Target audience of plan	○	○	○	○	○	○
Details of modifications to and updating of the plan	○	○	○	○	○	○
Plan activation (e.g. trigger levels etc)	○	○	○	○	○	○
Communication with other agencies	○	○	○	○	○	○
Communication with the public	○	○	○	○	○	○
Communication with the media	○	○	○	○	○	○
Relationship with complementary emergency management plans	○	○	○	○	○	○
Details of recovery	○	○	○	○	○	○
Training and exercises	○	○	○	○	○	○

Continue



« Back

Exit Survey »

91%

Q10 Please briefly list up to five criteria that you believe makes a Multi Agency Flood Plan effective?

Continue

« Back

Exit Survey »

100%

Q11 If you have any further comments that you wish to make about tools, methods or guidance that you believe could contribute to improving Multi Agency Flood Plans please add them to the box below.

Continue

Thank you for your time. The final project reports will be available from the project web site www.fimframe.net in 2011. However, interim results of the survey should be available to download from the FIM FRAME web site by May 2010. If you would like any further information please contact the project coordinator Darren Lumbroso by email at d.lumbroso@hrwallingford.co.uk.

Thank you for completing this survey

Appendix F Online survey carried out in France

Exit Survey »

8%

Bonjour,

Ce questionnaire a été réalisé afin de renseigner un projet de recherche européen intitulé *«Flood Incident Management, a FRAMEwork for improvement (FIM FRAME)»* www.fimframe.net. Ce projet fait partie du programme de recherche ERA-NET CRUE (www.crue-eranet.net), soutenu par le MEEDDM et plusieurs partenaires étrangers (Angleterre et Pays-Bas)

Le réseau CRUE a été mis en place pour renforcer les différents programmes de recherche européens sur les inondations, promouvoir les meilleures pratiques et identifier les lacunes et points positifs dans la gestion du risque inondation. Ses 16 partenaires, dont le Ministère de l'Ecologie et du Développement Durable, viennent des pays européens qui ont été particulièrement touchés par le risque inondation.

Le projet est piloté par le laboratoire HR Wallingford (Angleterre et Pays de Galles), en partenariat avec Deltares (Pays-Bas), le laboratoire Gester (Gestion des Sociétés, des Territoires et des Risques) de Université de Montpellier III (France) et le Laboratoire Central des Ponts et Chaussées (France).

Objectifs de la recherche:

- Les objectifs du projet sont:

1. Evaluer l'efficience et la robustesse des plans de gestion du risque inondation actuels en Angleterre, aux Pays-Bas et en France, et évaluer les méthodes qui pourraient permettre d'améliorer ces plans.
2. Evaluer les outils actuels utilisés en matière de planification de la gestion de crise inondation et la capacité de ces outils à perfectionner la gestion des futures crises liées aux inondations.
3. Etablir comment les outils actuels disponibles peuvent être utilisés pour améliorer les plans de gestion de crise «inondations» et identifier les éventuels manques au niveau de ces outils.
4. Fournir un cadre d'étude pour l'amélioration de la gestion de crise inondation à travers des études de cas en France, au Pays-Bas et en Angleterre.

- Les principaux objectifs du questionnaire sont:

1. Comprendre quelles sont les informations qui peuvent aider les gestionnaires de crise lors de l'établissement de «plans de gestion de crise inondations».
2. Connaitre les outils (méthodes, guide méthodologique, directive, logiciels d'aide à la décision etc) qui pourraient être développés afin d'aider à l'élaboration et à l'amélioration des « plans de gestion de crise inondations ».

Il est très important pour nous de connaître vos opinions.

Votre participation à cette étude est libre. Vous pouvez vous retirer de l'enquête à n'importe quel moment. Vos réponses au questionnaire seront strictement confidentielles et seuls les résultats généraux figureront dans le rapport. Les informations seront codées et resteront confidentielles. Si vous aviez des questions concernant le questionnaire ou la procédure, veuillez contacter Freddy Vinet par e-mail à freddy.vinet@univ-montp3.fr.

La réponse au questionnaire ne devrait pas prendre plus de dix minutes.

Nous vous remercions pour l'intérêt et le temps que vous consacrez à cette étude. Merci de commencer le questionnaire en cliquant sur le bouton suivant «continue».

Continue

LCPC Laboratoire Central des Ponts et Chaussées — CRUE FLOODING ERA-NET — Université Paul-Valéry Montpellier III

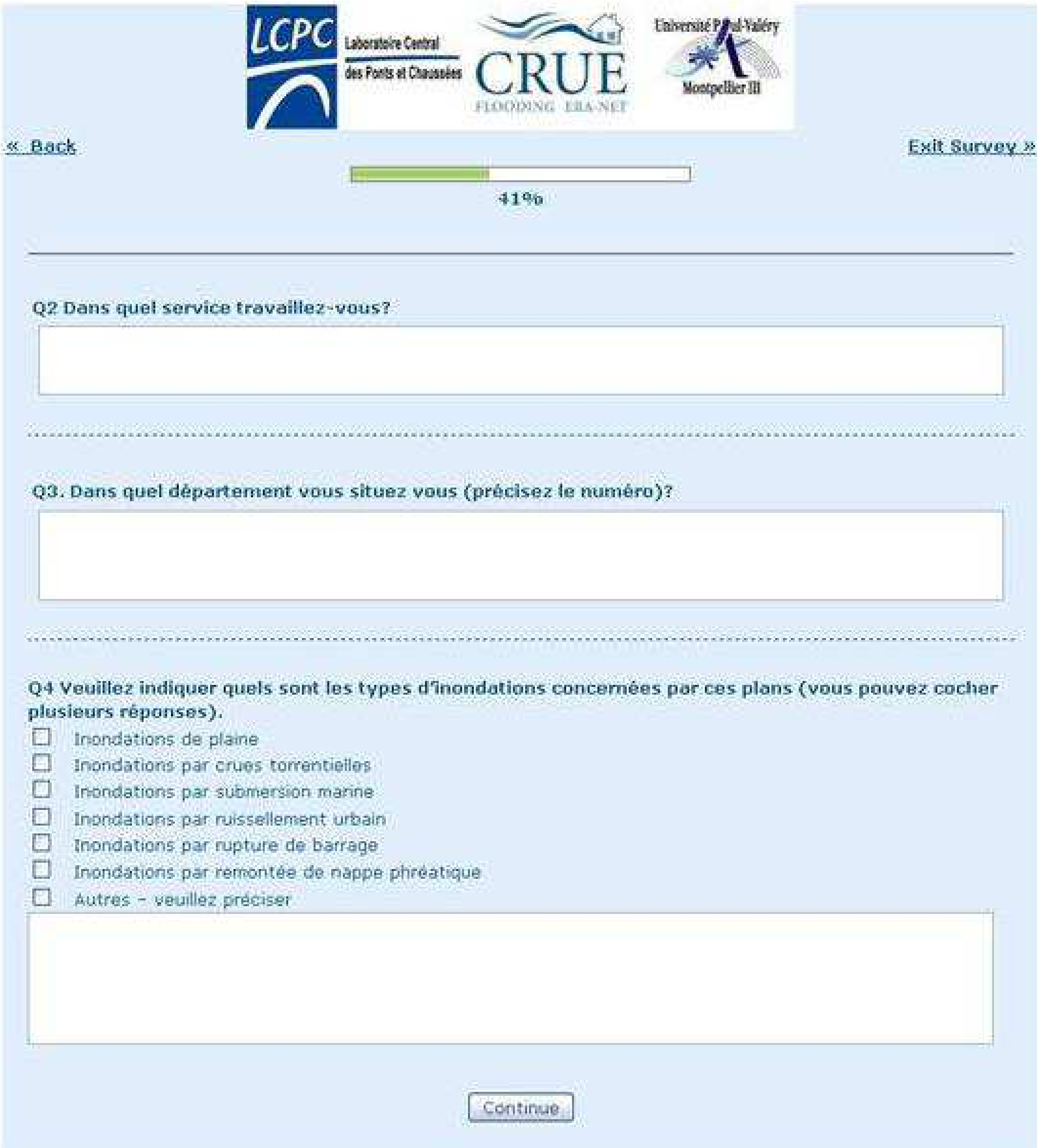
« Back   Exit Survey »

16%

Q1 Etes-vous actuellement responsable ou impliqué(e) dans la préparation d'un plan de gestion de crise «inondation» ?

- ○ Non
- ○ Ne sait pas
- ○ Oui, Plan ORSEC
- ○ Oui, Ordre d'opération Inondation
- ○ Oui, autre (préciser: PPI, PCS...)

Continue



« Back

Exit Survey »

41%

Q2 Dans quel service travaillez-vous?

Q3. Dans quel département vous situez vous (précisez le numéro)?

Q4 Veuillez indiquer quels sont les types d'inondations concernées par ces plans (vous pouvez cocher plusieurs réponses).

- ☐ Inondations de plaine
- ☐ Inondations par crues torrentielles
- ☐ Inondations par submersion marine
- ☐ Inondations par ruissellement urbain
- ☐ Inondations par rupture de barrage
- ☐ Inondations par remontée de nappe phréatique
- ☐ Autres - veuillez préciser

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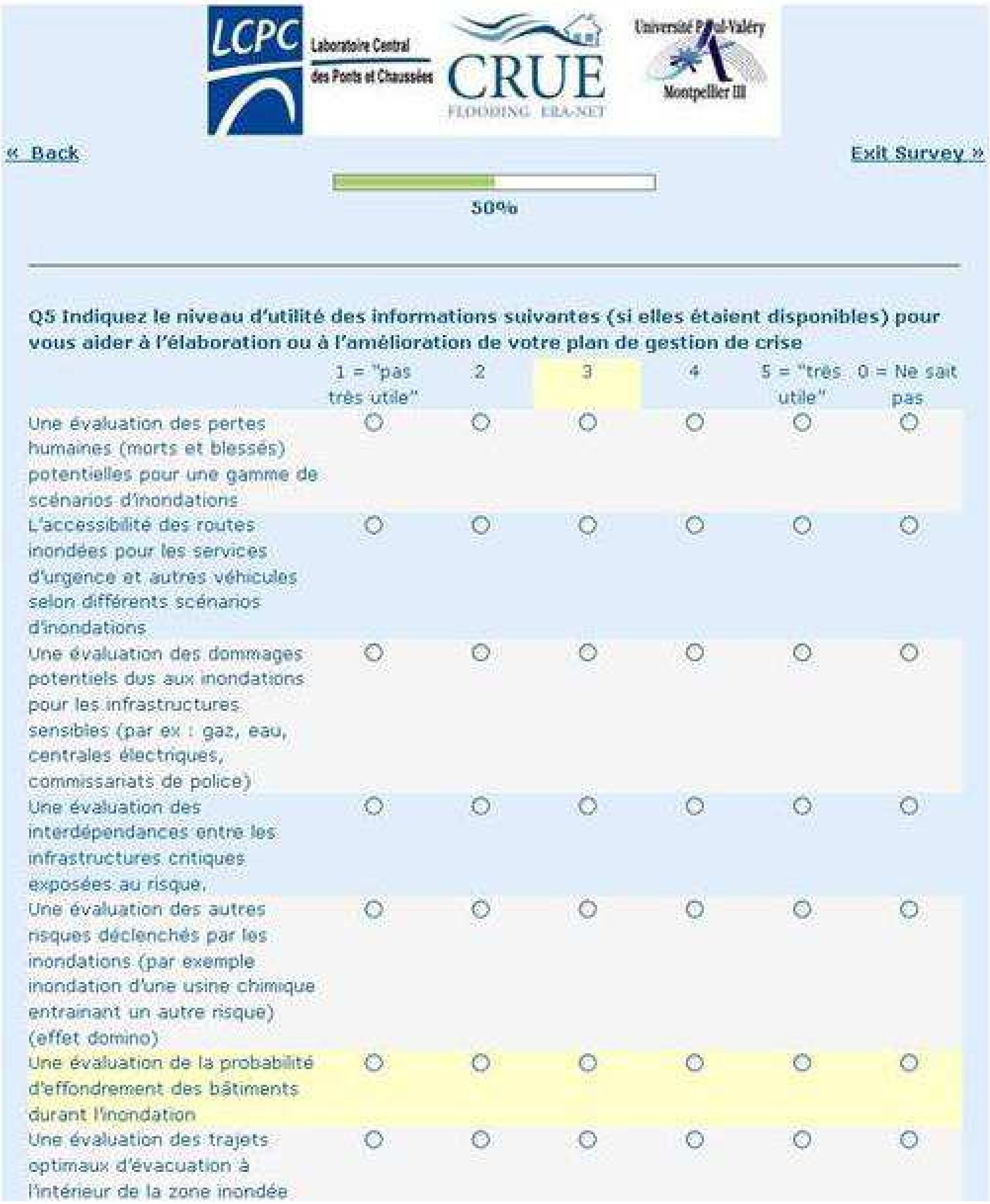


« Back   Exit Survey »

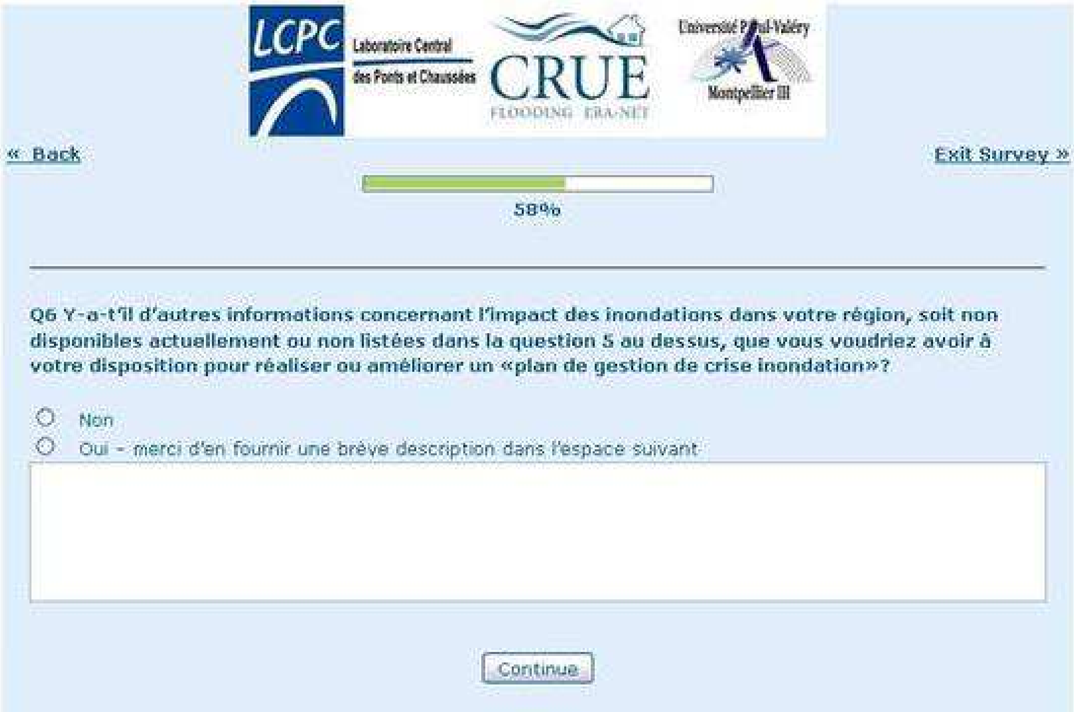
50%

Q5 Indiquez le niveau d'utilité des informations suivantes (si elles étaient disponibles) pour vous aider à l'élaboration ou à l'amélioration de votre plan de gestion de crise

	1 = "pas très utile"	2	3	4	5 = "très utile"	0 = Ne sait pas
Une évaluation des pertes humaines (morts et blessés) potentielles pour une gamme de scénarios d'inondations	○	○	○	○	○	○
L'accessibilité des routes inondées pour les services d'urgence et autres véhicules selon différents scénarios d'inondations	○	○	○	○	○	○
Une évaluation des dommages potentiels dus aux inondations pour les infrastructures sensibles (par ex : gaz, eau, centrales électriques, commissariats de police)	○	○	○	○	○	○
Une évaluation des interdépendances entre les infrastructures critiques exposées au risque.	○	○	○	○	○	○
Une évaluation des autres risques déclenchés par les inondations (par exemple inondation d'une usine chimique entrainant un autre risque) (effet domino)	○	○	○	○	○	○
Une évaluation de la probabilité d'effondrement des bâtiments durant l'inondation	○	○	○	○	○	○
Une évaluation des trajets optimaux d'évacuation à l'intérieur de la zone inondée	○	○	○	○	○	○

humaines (morts et blessés) potentielles pour une gamme de scénarios d'inondations						
L'accessibilité des routes inondées pour les services d'urgence et autres véhicules selon différents scénarios d'inondations	○	○	○	○	○	○
Une évaluation des dommages potentiels dus aux inondations pour les infrastructures sensibles (par ex : gaz, eau, centrales électriques, commissariats de police)	○	○	○	○	○	○
Une évaluation des interdépendances entre les infrastructures critiques exposées au risque.	○	○	○	○	○	○
Une évaluation des autres risques déclenchés par les inondations (par exemple inondation d'une usine chimique entrainant un autre risque) (effet domino)	○	○	○	○	○	○
Une évaluation de la probabilité d'effondrement des bâtiments durant l'inondation	○	○	○	○	○	○
Une évaluation des trajets optimaux d'évacuation à l'intérieur de la zone inondée	○	○	○	○	○	○
Une évaluation du temps mis pour évacuer les personnes dans les zones exposées à l'inondation.	○	○	○	○	○	○
Une évaluation de la réduction de la vulnérabilité des personnes associée à une amélioration de la diffusion des alertes	○	○	○	○	○	○
Une évaluation de la localisation optimale des abris et des zones d'hébergement	○	○	○	○	○	○

Continue



« Back

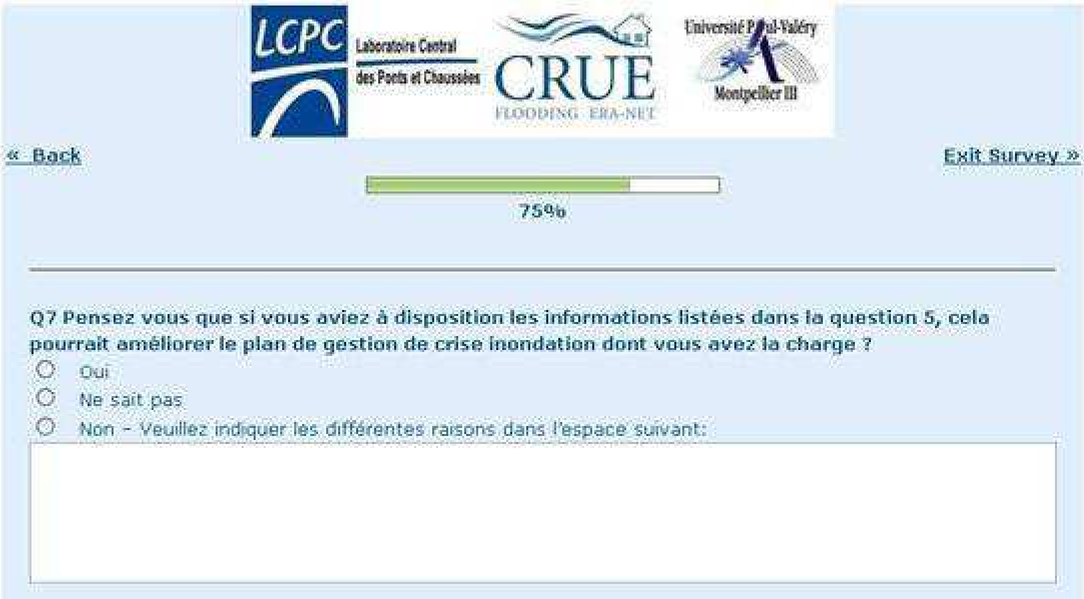
Exit Survey »

58%

Q6 Y-a-t'il d'autres informations concernant l'impact des inondations dans votre région, soit non disponibles actuellement ou non listées dans la question 5 au dessus, que vous voudriez avoir à votre disposition pour réaliser ou améliorer un «plan de gestion de crise inondation»?

- Non
- Oui - merci d'en fournir une brève description dans l'espace suivant

Continue



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Exit Survey »

75%

Q7 Pensez vous que si vous aviez à disposition les informations listées dans la question 5, cela pourrait améliorer le plan de gestion de crise inondation dont vous avez la charge ?

- Oui
- Ne sait pas
- Non - Veuillez indiquer les différentes raisons dans l'espace suivant:

Q8 Parmi les informations et données suivantes, veuillez indiquer quel est selon vous le niveau de détail à faire figurer dans les plans pour permettre une bonne gestion de crise inondation?

	1 = Pas utile	2 = Peu détaillé	3 = Moyennement détaillé	4 = Assez détaillé	5 = Très détaillé	0 = Ne sait pas
Délai d'anticipation de l'alerte aux inondations	○	○	○	○	○	○
Cartographie montrant l'extension de l'inondation	○	○	○	○	○	○
Cartographie des hauteurs d'eau, des vitesses et des zones d'écoulement majeurs	○	○	○	○	○	○
Vulnérabilité des personnes en termes de blessures et décès potentiels	○	○	○	○	○	○
Vulnérabilité des bâtiments	○	○	○	○	○	○
Impact des inondations sur les infrastructures sensibles	○	○	○	○	○	○
Temps et trajets d'évacuation	○	○	○	○	○	○
Potentialité qu'un autre risque se produise suite à une inondation	○	○	○	○	○	○
Abris, zones de repos et refuges sécurisés	○	○	○	○	○	○
Efficacité de la mise en place de mesures de sauvegarde temporaires (sacs de sables, défenses temporaires)	○	○	○	○	○	○
Ressources appropriées mobilisables (matérielles et humaines)	○	○	○	○	○	○

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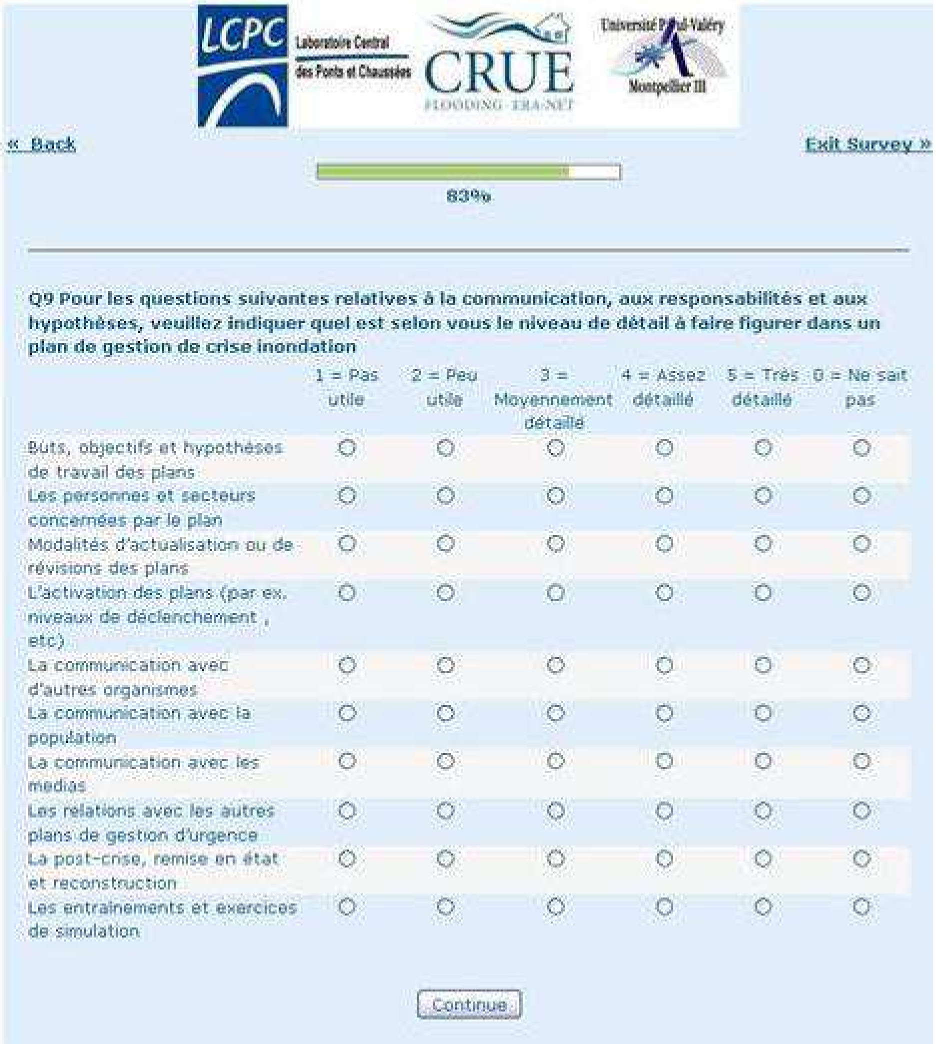
« Back Exit Survey »

83%

Q9 Pour les questions suivantes relatives à la communication, aux responsabilités et aux hypothèses, veuillez indiquer quel est selon vous le niveau de détail à faire figurer dans un plan de gestion de crise inondation

	1 = Pas utile	2 = Peu utile	3 = Moyennement détaillé	4 = Assez détaillé	5 = Très détaillé	0 = Ne sait pas
Buts, objectifs et hypothèses de travail des plans	○	○	○	○	○	○
Les personnes et secteurs concernées par le plan	○	○	○	○	○	○
Modalités d'actualisation ou de révisions des plans	○	○	○	○	○	○
L'activation des plans (par ex. niveaux de déclenchement , etc)	○	○	○	○	○	○
La communication avec d'autres organismes	○	○	○	○	○	○
La communication avec la population	○	○	○	○	○	○
La communication avec les medias	○	○	○	○	○	○
Les relations avec les autres plans de gestion d'urgence	○	○	○	○	○	○
La post-crise, remise en état et reconstruction	○	○	○	○	○	○
Les entraînements et exercices de simulation	○	○	○	○	○	○

Continue

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Exit Survey »

91%

Q10 Pouvez-vous citer brièvement cinq critères qui font l'efficacité d'un plan de gestion de crise inondation?

Continue

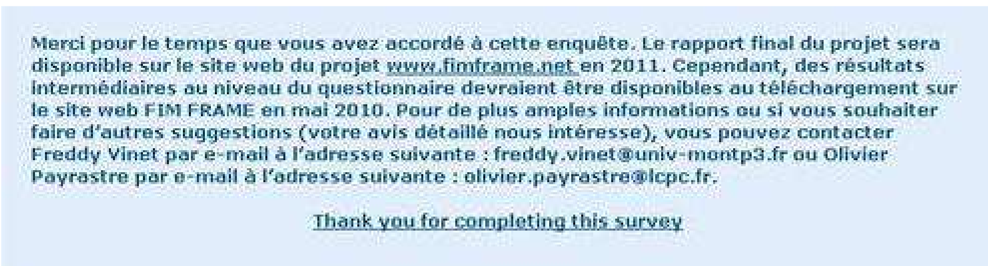
« Back

Exit Survey »

91%

Q10 Pouvez-vous citer brièvement cinq critères qui font l'efficacité d'un plan de gestion de crise inondation?

Continue



Merci pour le temps que vous avez accordé à cette enquête. Le rapport final du projet sera disponible sur le site web du projet www.fimframe.net en 2011. Cependant, des résultats intermédiaires au niveau du questionnaire devraient être disponibles au téléchargement sur le site web FIM FRAME en mai 2010. Pour de plus amples informations ou si vous souhaiter faire d'autres suggestions (votre avis détaillé nous intéresse), vous pouvez contacter Freddy Vinet par e-mail à l'adresse suivante : freddy.vinet@univ-montp3.fr ou Olivier Payrastre par e-mail à l'adresse suivante : olivier.payrastre@lcpc.fr.

Thank you for completing this survey

Appendix G Online survey carried out in the Netherlands

Exit Survey »

7%

Geachte mevrouw, mijnheer,

Deze korte enquête (minder dan 10 minuten) vindt plaats in het kader van het Europese onderzoeksproject Flood Incident Management a FRAMEwork for improvement (FIM Frame, www.fimframe.net).
- Het FIM Frame project is onderdeel van het Europese onderzoeksprogramma ERA-NET CRUE (www.crue-eranet.net).
- Doel van het CRUE programma is het versterken van bestaande Europese onderzoeken m.b.t. overstromingsrisico, het promoten van 'best practices' en het identificeren van behoeftes en kansen voor toekomstige samenwerking tussen Europese landen.
- Het FIM Frame project wordt geleid door het Engelse onderzoeksinstituut HR Wallingford. Verder werken aan het project mee: Deltares (Nederland), Universiteit van Montpellier (Frankrijk) en Laboratoire Central des Ponts et Chausées (Frankrijk).

De doelen van het FIM Frame project zijn:
- Het evalueren van de effectiviteit en robuustheid van huidige rampenplannen voor overstromingen in Groot-Brittannië, Nederland en Frankrijk en het evalueren van methoden waarmee de plannen verbeterd kunnen worden.
- Het verkrijgen van overzicht van (potentiële) instrumenten (methoden, richtlijnen, handleidingen, software etc) die gebruikt worden bij het maken van rampenplannen en inzicht in en de meerwaarde van deze instrumenten bij het opstellen van de rampenplannen.
- Het bepalen hoe de beschikbare instrumenten gebruikt kunnen worden om rampenplannen te verbeteren en het identificeren van lacunes m.b.t. instrumenten.
- Het ontwikkelen van een kader (framework) te gebruiken om rampenplannen te verbeteren. Het kader zal getoetst worden binnen verschillende pilot gebieden in Nederland, Groot-Brittannië en Frankrijk.

Deze enquête wordt gehouden in het kader van het eerste en tweede projectdoel en moet inzicht geven in de informatie en instrumenten die kunnen bijdragen bij het opzetten van rampenplannen.

Wij waarderen het zeer indien u bereid bent deel te nemen aan deze enquête omdat uw inbreng erg waardevol voor ons zal zijn. Uw deelname aan deze enquête is geheel vrijwillig.

Uw antwoorden op de enquête vragen zijn anoniem. In aanvulling worden de resultaten gecodeerd. Met uw reacties zal vertrouwelijk worden omgegaan en resultaten van de enquête worden alleen gebruikt voor het FIM Frame project en door het FIM Frame projectteam. Indien u vragen hebt over de enquête of de procedure, dan kunt u contact opnemen met Karin Stone (karin.stone@deltares.nl) of Darren Lumbroso (d.lumbroso@hrwallingford.co.uk.).

Het invullen van deze enquête kost niet meer dan 10 minuten. Namens het projectteam dank ik u voor uw tijd. U kunt de enquête opstarten door op de 'Continue' knop te klikken.

Continue

« Back

Exit Survey »

15%

In de enquête wordt de term 'rampenplan' gebruikt. Onder rampenplan wordt rampen- of crisisplannen en de onderliggende rampen- of crisisbestrijdingsplannen verstaan.

Q1. Bent u momenteel betrokken en/of verantwoordelijk voor het opstellen van rampenplannen?

- ○ Ja
- ○ Nee
- ○ Onduidelijk

Continue

« Back

Exit Survey »

30%

Q2 Bij het opstellen van welk rampenplan bent u betrokken.

-- Select --

Q3 Kunt u aangeven met welke type overstroming u in uw gebied te maken heeft? (meerdere antwoorden mogelijk).

- ☐ Overstroming vanuit de grote rivieren
- ☐ Overstroming vanuit zee
- ☐ Overstroming vanuit regionale wateren (boezemwateren, beken etc.)

Continue

Q4 Kunt u voor de hieronder genoemde informatie aangeven of deze (potentieel) van nut is bij het opstellen van rampenplannen en indien ja, welk detailniveau gewenst is om effectief te zijn.

	"Niet nuttig"	1 = "Laag detailniveau"	2	3	4	5 = "Hoog detail niveau"	"Geen mening"
Voorspellingstijden	○	○	○	○	○	○	○
Omvang overstromingsgebied	○	○	○	○	○	○	○
Waterdiepte, stroomsnelheden en verloop overstroming	○	○	○	○	○	○	○
Slachtoffer risicokaarten	○	○	○	○	○	○	○
Potentiele Schadekaarten	○	○	○	○	○	○	○
Kwetsbaarheid en/of Risicokaarten	○	○	○	○	○	○	○
Impact op kritieke infrastructuur	○	○	○	○	○	○	○
Optimale evacuatie routes	○	○	○	○	○	○	○
Benodigde tijd om te evacueren	○	○	○	○	○	○	○
Keteneffecten (bv. een chemische ramp a.g.v. een overstroming)	○	○	○	○	○	○	○
Optimale shelters en opvang locaties	○	○	○	○	○	○	○
Effect van toepassen van maatregelen (bv. zandzakken, tijdelijke keringen)	○	○	○	○	○	○	○
Beschikbaarheid resources	○	○	○	○	○	○	○
De toegankelijkheid van geinundeerde wegen voor hulpdiensten en andere voertuigen	○	○	○	○	○	○	○
Kans op instortingsgevaar van gebouwen	○	○	○	○	○	○	○
Het effect van risicocommunicatie en waarschuwing	○	○	○	○	○	○	○

Continue

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Exit Survey »

46%

Q5 Van welk van onderstaande informatie bent u al op de hoogte van het bestaan of wordt nu al gebruikt bij het opstellen van de rampenplannen voor overstromingen binnen uw organisatie.

	"Op de hoogte"	"Gebruikt bij plannen"
Voorspellingstijden	○	○
Omvang overstromingsgebied	○	○
Waterdiepte, stroomsnelheden en verloop overstroming	○	○
Slachtoffer risicokaarten	○	○
Potentiële Schadekaarten	○	○
Impact op kritieke infrastructuur	○	○
Optimale evacuatie routes	○	○
Benodigde tijd om te evacueren	○	○
Keteneffecten (bv. een chemische ramp a.g.v. een overstroming)	○	○
Optimale shelters en opvang locaties	○	○
Effect van implementatie van maatregelen (bv. zandzakken, tijdelijke keringen)	○	○
Beschikbaarheid resources	○	○
De toegankelijkheid van geinundeerde wegen voor hulpdiensten en andere voertuigen	○	○
Kans op instortingsgevaar van gebouwen	○	○
Het effect van risicocommunicatie en waarschuwing	○	○

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53%

Q6 Is er nog andere informatie die binnen uw gebied wordt gebruikt of waar u behoefte aan heeft welke niet in deze lijst is genoemd?

- ○ Nee
- ○ Ja – Kunt u in de onderstaande box een korte beschrijving van deze informatie geven.

Continue

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61%

Q7 Indien u de beschikking heeft over de door u als nuttig aangemerkte informatie in vraag 4, 5 en 6, zou dit bijdragen aan een verbetering van het rampenplan.

- ○ Ja
- ○ Ik weet het niet
- ○ Nee – Kunt u dit alstublieft motiveren in onderstaande box.

Continue

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Exit Survey »

69%

Q8 Kunt u voor de hieronder genoemde onderdelen van een rampenplan aangeven tot welk detailniveau deze uitgewerkt dient te zijn om effectief te zijn.

	1 = "laag detailniveau"	2	3	4	5 = "hoog detail niveau"	"Geen mening"
Doelen en aannames	○	○	○	○	○	○
Doelgroep	○	○	○	○	○	○
Planning rond update en versiebeheer	○	○	○	○	○	○
In werking treding plan. (bv alarmfases)	○	○	○	○	○	○
Communicatie tussen partijen	○	○	○	○	○	○
Publieke voorlichting	○	○	○	○	○	○
Communicatie naar de media en	○	○	○	○	○	○
Relatie met andere (deel)plannen.	○	○	○	○	○	○
Herstel na ramp	○	○	○	○	○	○
Training en opleiding	○	○	○	○	○	○
Organisatie (verantwoordelijkheden, leiding en coördinatie)	○	○	○	○	○	○
Uitgewerkte actieplannen, bv. specifieke plannen voor evacuatie, toepassen maatregelen, slachtofferzorg	○	○	○	○	○	○
Mensen en middelen	○	○	○	○	○	○
Verslaglegging (logboeken e.d.)	○	○	○	○	○	○
Overstromingsscenario's inclusief onzekerheid	○	○	○	○	○	○

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76%
Q9 Wat zijn volgens u de 5 belangrijkste criteria die bepalen of een rampenplan voor overstromingen effectief is?
Continue

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100%

Q10 Maakt uw organisatie gebruik van instrumenten (methodes, richtlijnen, handleidingen, software etc) bij het opmaken van rampenplannen?

○ Nee

○ Ja, namelijk:

Q11 Heeft u aanvullende behoefte aan (al dan niet bestaande) instrumenten die kunnen bijdragen aan het verbeteren van rampenplannen voor overstromingen?

○ Nee

○ Ja, namelijk:

Q 12 In onderstaande box kunt u eventuele aanvullende opmerkingen of aanvullingen geven.

Hartelijk dank voor uw tijd. De definitieve project resultaten zullen in 2011 beschikbaar komen op de project website (www.fimframe.net). Resultaten van deze enquête zullen vanaf mei 2010 via de project website beschikbaar gesteld worden. Voor vragen en informatie kunt u ook contact opnemen met Karin Stone (karin.stone@deltares.nl) of de project coördinator Darren Lumbroso (d.lumbroso@hrwallingford.co.uk).

Thank you for completing this survey

Appendix H Results of English and Welsh survey

Table H1 Please indicate the level of usefulness of the following information, if it were available, in assisting you with the formulation of Local Resilience Forum Multi Agency Flood Plans?

Percentage of responders for each "level" of usefulness	**Potential injuries and loss of life for a range of flood scenarios**	**The accessibility of inundated roads to emergency services and other vehicles for different flood scenarios**	**Potential damage to critical infrastructure**	**The inter-dependencies between at risk critical infrastructure**	**Other hazards triggered as the result of flooding**	**Probability of buildings collapsing during a flood**	**Optimal evacuation routes from the inundated area**	**The time to evacuate people from areas at risk of flooding**	**How improvements in the dissemination of flood warnings could reduce the risk to people**
1 = Not very useful	4%	0%	1%	1%	1%	1%	0%	1%	3%
2	11%	1%	0%	1%	3%	5%	1%	5%	8%
3	23%	3%	5%	4%	11%	26%	10%	12%	14%
4	20%	23%	16%	31%	22%	**32%**	19%	16%	25%
5 = Very useful	**36%**	**70%**	**76%**	**61%**	**61%**	**32%**	**64%**	**61%**	**49%**
0 = Don't know	5%	3%	1%	1%	3%	4%	6%	4%	1%

Table H2 **Please indicate what you believe is the most appropriate level of detail for the following information and data in a Multi Agency Flood Plan?**

Percentage of responders for each "level" of detail	**Flood warning lead times**	**Flood map showing flood extent**	**Flood map showing depths, velocities and flow routes**	**Flood risk to people in terms of potential injuries and loss of life**	**Flood risk to properties**	**Impacts of floods on critical infrastructure**	**Evacuation routes and times**	**Potential for other hazards that may occur because of flooding**	**Shelters, rest areas and safe havens**	**Implementation of measures (e.g. sand bags, temporary defences)**	**Availability of the appropriate resources**
1 = Not detailed in the plan	1%	0%	0%	1%	1%	0%	1%	1%	0%	1%	0%
2	1%	1%	4%	9%	4%	0%	3%	4%	4%	8%	7%
3	18%	6%	18%	20%	19%	7%	17%	30%	30%	**41%**	30%
4	39%	44%	**39%**	**36%**	**44%**	37%	**39%**	**43%**	**37%**	28%	**38%**
5 = Very detailed	**40%**	**49%**	38%	33%	31%	**56%**	38%	20%	30%	21%	25%
0 = Don't know	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%

Table H3 **Please indicate what you believe is the most appropriate level of detail for the following issues related to communication, responsibilities and assumptions in a Multi Agency Flood Plan?**

Percentage of responders for each "level" of detail	**Aims, objectives and assumptions of plan**	**Target audience of plan**	**Details of modifications to and updating of the plan**	**Plan activation (e.g. trigger levels etc)**	**Communication with other agencies**	**Communication with the public**	**Communication with the media**	**Relationship with complementary emergency management plans**	**Details of recovery**	**Training and exercises**
1 = Not detailed in the plan	0%	0%	0%	0%	0%	0%	0%	0%	1%	4%
2	9%	13%	14%	0%	0%	0%	0%	4%	6%	13%
3	31%	34%	33%	6%	9%	10%	16%	20%	20%	19%
4	**39%**	**40%**	**43%**	36%	39%	41%	40%	**43%**	**53%**	**51%**
5 = Very detailed	21%	13%	9%	**58%**	**53%**	**49%**	**44%**	33%	20%	13%
0 = Don't know	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Q6 Is any other information related to the impacts of flooding in your area, either not currently available or listed in Question 5 above, that you would like to have available to assist you in formulating Multi Agency Flood Plans?

All the comments relating to this question have been grouped into the headings below.

Flood hazard maps
- Extent and depth of flood water for a variety of scenarios
- Water depth/velocity/hazard mapping, but currently understand that this will be available from the Environment Agency (EA), as will impact of blockage scenarios.
- Depth of flood water for a range of scenarios (e.g. for a one in 5 year event, 1 in 10 year event etc). At the present time we have a line on a map one side is flooded the other isn't... but no indication of depth, this makes writing credible plans extremely difficult.
- Availability of flood modelling maps
- Improved mapping
- The current flood maps (i.e. 1 in 100 years) are useful for deciding if you live in a potentially vulnerable area but don't really help the response - e.g. knowing which areas are going to be affected first, prioritising evacuation etc.

Critical infrastructure
- The levels that impinge upon water treatment works
- Levels where structural stability of bridges would be questioned.
- Potential impacts on critical communications suppliers
- Location of critical national Infrastructure, but there are obvious problems with that.
- Where critical infrastructure identified within a flood footprint, the estimated footprint of area affected by the loss of that infrastructure
- Difficulties are being experienced in obtaining some information regarding the critical infrastructure surrounding the utilities, they say in respect of security
- Flood equipment and location availability

Evacuation and transport
- Factoring in the vulnerable nature of the evacuees and the impact on the time to evacuate.
- Scenarios with linked impacts and information on best evacuation routes etc - but those which can be prepared beforehand are unlikely to match the real event
- Pre planned transport diversion routes
- History of road surface water flooding may be useful
- Impacts on main railways as well as roads
- Evacuation time and routes in case of reservoir inundation

Trigger and forecast levels
- Trigger levels for flooding of areas other than standard gauge points
- Formal identification of individual agencies ""trigger"" points.
- It would be very useful to have access to maps which show the extent of flooding at different gauge levels: i.e. at 3.6 metres, this area will be flooded. At 3.8 metres, this area will be flooded. At 4.2 metres, this area will be flooded.
- Web availability of river levels and forecast levels
- Information on lead times, peaks etc during a flood event

Flood Warnings
- The current Flood Warning fax system is being reviewed. Police respond to actual incidents happening so any warning must indicate that response is required. Too many false alarms or 'standby' warnings at too low a threshold are of no value, and actually devalue the impact of a required response. The warning must be clear and effective and as accurate as possible.

- We have reservations about the need to change Flood Warnings - they are meaningful and have proven to work well; the public are used to them and take action.
- Flood Warnings must remain meaningful and workable as they are at present.
- It is difficult to see how the proposed changes and the levels at which Flood Warnings will be issued will be effective on the ground. Communities at greatest risk are already well prepared and cope with regular flooding. Communities at risk when Severe Warnings are currently issued may be disenfranchised as there will not be any Severe Warnings.

Other comments

- Identified areas to pump water to in the event of flooding, this would eliminate the second guess.
- Recovery - likely times frames for repairing damaged property.
- Length of time for standing flood water to drain away.
- Critically, historical rainfall from the Met Office and where it has led to surface water problems. This then becomes a potential trigger for future events. currently this information costs from the Met Office and is therefore unavailable.
- The major of the information in Question 5 I don't currently have.

Q10 Please briefly list up to five criteria that that you believe makes a Multi Agency Flood Plan effective?

1. Generic Response required by different types of flooding
2. Specific location differences and considerations
3. Maps showing the extent and assets within the specific locations
4. Community Impact Assessments (CIA)
5. Prioritised approach and risk assessment process that identifies the specific locations requiring CIAs

1. Clear and simple to use
2. Availability of data

1. Effective partnership working to develop the plan
2. The correct level of detail dependent on the status of the plan i.e. strategic, tactical or operational
3. Training and exercising
4. Incorporating lessons learned following training, exercising or a real incident
5. Communication

1. Clear and unambiguous information
2. Testing and exercising the plan
3. Good quality up to date flood maps
4. Quality annexes with geo-codes for site specific information
5. Document not too weighty

1. Asset Database for all culverts rivers etc
2. Locations of flooding area including UU provided on a data base
3. use of experienced of local Highways staff in providing data for plan
4. list of proposed developments/civil works affecting drainage new housing developments
5. working together with other agencies

1. Consultation
2. Clarity
3. Do not duplicate information found in other Plans
4. Good lead time
5. Detail of flood extent including depths and velocities
6. Evacuation routes and times
7. Compromised and available protection measures for critical infrastructure

1. Not duplicate contents of other plans but provide a quick route to the information needed.
2. Simple language, easy to reference and use with maximum use of maps, tables, diagrams, charts and minimum use of paragraphs of text.
3. Be available in electronic and paper format, interactive GIS and real time/forecast animations of flooding area and consequences etc. incl. automated outputs.
4. Be proportionate in the amount of detail contained reflecting the degree of risk to life, not too prescriptive and be flexible and able to take account of real time strategic and tactical considerations and decision making (not a tick box approach!)
5. Involve/consult users in its development and delivery, regular training, testing and updating and be adopted/integrated as an essential tool in the emergency planning and response kit bag as opposed to a 'bolt on'

1. Maps of areas that would be affected
2. Details of critical Infrastructure that would be affected
3. Details of population that would be affected i.e. numbers and any hospitals or disabled people
4. Evacuation plans
5. Details of rest centres

1. Clear Activation Procedures.
2. Highlighting critical infrastructure and how it is impacted.
3. Highlighting vulnerable people and areas
4. Clear inter-organisational communication structures

1. Accurate roles & responsibilities
2. Detailed information on lead times for flooding
3. Detailed information on flood risk areas
4. Accurate contact details & resource information
5. Methods of public warning & informing available

1. Multi-agency input in the development of the plan.
2. Multi-agency involvement in the testing and exercising of the plan.
3. Very clear communication links between agencies.
4. Explicit trigger/activation points (or as best as possible).
5. Understanding of the impact of flooding in neighbouring areas and their local flood plans

1. Activation & trigger Levels
2. Scope
3. Communication between parties & defined communication lines
4. Risk impact
5. Maps and visualisation tools

1. Roles and responsibilities of agencies related to flood incident response
2. Detailed maps as per previous
3. C(N)I considerations

1. Clear trigger points
2. Clear contact databases
3. Clear Roles and responsibilities of partner organisations
4. Clear media strategy
5. Clear response and recovery strategy and handover points

1. Audience
2. Trigger levels
3. Roles of each agency

4. Contact details for each agency
5. Risk levels in county

1. Ease of use
2. If electronic hyperlinks are useful
3. Information to the point - actions
4. No background detail
5. Regular review and update

1. Simplicity with regard to usage.
2. Clearly defined actions required at defined locations and timescales.
3. Clear understanding of what actions agencies are able/willing to undertake.
4. Reviews and amendments that are relative.

1. Usefulness of the plan (i.e. user friendly with the right information).
2. Sign post to other relevant plans.
3. Consistency of Information (in particularly with other plans).
4. Actions chart in the early stages of the plan (with sign posts to relevant sections of the plan should further details be required to assist decision making)."
5. Maximum lead in time, good understanding of flooding extent and optimum use of available resources.

1. Aim
2. Scope
3. Objectives
4. Roles and responsibilities
5. Contact details

1. All agencies contribute fully
2. Clarity about who does what when
3. Reliable and fully shareable data, preferably live

1. Awareness and availability of plan to relevant responders
2. Detail of extent of flooding
3. Detail of critical facilities
4. Detail of mitigation resources
5. Contact information for other responders

1. Aim
2. Triggers
3. Roles and responsibilities
4. contact lists
5. Voluntary sector assistance

1. Effective communication
2. Comprehensive planning
3. Exercises
4. Multidisciplinary working relationships
5. Debrief

1. Quick and easy to interpret and draw immediate conclusions from, even from people not expert in the data behind it
2. Enough detail to enable effective response, but not so much as to imply false accuracy in predicting a scenario, or to impede quick response

3. All decisions and provisions that can be made before hand; have been - e.g. rest centres established and full details given
4. Does not contain detail that is likely to become out of date quickly (such as contact numbers) - rather a link to where the up to date information can be found

1. A clear trigger
2. Accuracy
3. Ease of access to plan
4. Comprehensiveness
5. Multi agency contribution
6. Prior training and exercising to generate familiarity with plan

1. Clearly identified areas at risk
2. Clear and detailed trigger points
3. Detailed roles and responsibilities of responding agencies
4. Safe pre-designated evacuation routes to pre-identified Welfare/Rest Centres
5. Interdependencies with other response plans/arrangements

1. Easy to use
2. Clear, concise actions
3. Short
4. Plenty of maps
5. Clear communication strategy

1. Contains accurate and reliable information on which areas will flood and when
2. Effective communication between organisations, the public and the media
3. A clear structure for how the response will be co-ordinated between organisations and at the strategic, tactical and operational level
4. Operational procedures (e.g. delivery and prioritisation of sandbags, collating information on road closures)

1. Details on population to be affected
2. Actions plans for those required to respond
3. Prepared public info
4. risk assessment of flood warnings
5. training and awareness

1. Who responds
2. What each responder has responsibility for
3. Where the target area(s) is for responders and where they liaise
4. When they respond (trigger levels)
5. Why (circumstances /sitrep)

1. Differentiate between a flood plan and flood guidance. (A flood plan should be to activate and set structure in place. Guidance provides greater info) Mixing the two makes a plan unusable in crisis.
2. Clear Activation processes
3. Remove any vague words - should, may, might,. replace with commands - -will, must etc
4. Plan needs to be short and to the point
5. Clear mapping"

1. Who is going to use it?
2. How it is triggered and by whom?
3. Up-to-date contacts and arrangements
4. Who does what, when and how?
5. Mutual Aid arrangements

1. Clear Roles and Responsibilities
2. Clear focus, scope and objectives
3. Clear communication routes
4. Document is clear on the level of response i.e. the plan is strategic, tactical or operational – not a mixture.
5. Concisely written

1. Clarity of Roles & Responsibilities of responding agencies
2. Regular Consultation between emergency responders on Plan Content (effective LRF involvement)
3. Local information (e.g. based on District Council Area) for local operational staff
4. Operational Response meetings annually
5. Good cross-referencing to other supporting emergency arrangements - eg rest centres / recovery plans

1. Details of areas at risk of flooding
2. Impact of flooding on critical infrastructure
3. Activation triggers of plan
4. Activating command and control structures
5. Evacuation and shelter information

1. Clear definition of agency roles and responsibilities and links to related plans.
2. Detailed mapping of potential flooding scenarios.
3. An indication of threats to CNI (although protective marking may reduce usefulness) or other critical infrastructure.
4. Appendices for each agency to outline threats to their own individual Business Continuity from flooding scenarios of different magnitudes.
5. Outline of potential recovery strategies which may be assisted by early decisions in the response phase.

1. Useable- i.e. not overly long
2. Clear audience- i.e. who is it designed to be used by
3. Clear activation, trigger and actions taken by who at each stage
4. Not duplicating information in other plans - this seemed to be the case in the last checklist. as long 5 as info can be sourced from another plan or signposted to another system (i.e. vulnerable people)

1. Clear Triggers
2. Roles and Responsibilities
3. Actions per agency
4. Communication
5. Recovery

1. Clearly identifying the area potentially affected and the impact of the flooding
2. Highlight to the silver commander what he needs to consider; local of key locations to evacuate and key infrastructure to protect
3. Clearly identified triggers with lead-in times, including reference to past rainfall and consequences
4. An 'owner' - who is monitoring weather conditions and starts the activation process
5. It must be practical for a gold/silver commander. if they need to wade through many different templates to get a picture of all the places that flood and the consequences, it will be hard to formulate a co-ordinated and prioritised response. Perhaps an IT alternative supports the plan, making the decision-making easier in practise. "

1. Activation triggers
2. Related Plans
3. What responders are doing and when

4. Risks for specific areas
5. Recovery planning

1. Clear Roles and Responsibilities,
2. Identification of critical infrastructure;
3. Clear triggers to actions, responses, command and control, evacuation;
4. Good mapping availability to support all agencies;
5. Good continuity and recovery plans"

1. Clear definition and guidance on how the plan is activated.
2. Multi-agency cohesion detailed in the plan
3. Maps and visual aids for assistance in effective decision making
4. Distinctive links between the various levels of warning and what resources each one triggers
5. Infrastructure information"

1. Partner involvement
2. Awareness across the EP world
3. Clear lines of communication
4. Roles & responsibilities"

1. Clear info on likely areas/footprints and what is within the area(s)
2. Activation procedures
3. Communication links
4. Identifying critical infrastructure within flooded area and an understanding of the effect of losing any of that infrastructure
5. Clear understanding of each agencies response capabilities

1. Information flow
2. Warning the public
3. Trigger levels

1. Includes CNI
2. Sets out triggers
3. Sets out roles and responsibilities
4. Sets out flood extent and impacts

1. Communication
2. Planning
3. Historical data
4. Risk assessments

1. Roles and Responsibilities of organisations
2. Detailed flood maps
3. Flow charts
4. Action cards for various flood warnings
5. Related plans

1. Better awareness of partner agencies capabilities
2. Better awareness of equipment/manpower availability
3. Agreed trigger levels to stop agencies working in isolation
4. More coordinated response for dealing with the public and media
5. Ensures partner agencies retain flooding on their agenda

1. Activation
2. Triggers

3. Mapping
4. Actual roles and responsibilities
5. Definition of evacuation vs rescue

1. Produced locally
2. Arrangements flexible enough to adapt to individual circumstances
3. Usability
4. Identifies key priorities for consideration by Gold command

1. Content actively reviewed by all key responding agencies and responsibilities agreed
2. Content gives sufficient details to enable responders to understand the topography and specific characteristics of the flood risk in the area covered.(NB chief officers in some organisations may never have been involved in a flooding incident)
3. Content provides clear steps and data for consideration of responses to the early stages of a flooding incident (for e.g. how to use the Environment Agency warnings, contact details of Environment Agency Flooding Incident officers etc)
4. Content provides clear view of roles of key agencies.
5. MAFP exercised and actively debriefed

1. Details of where it will flood
2. Numbers affected by potential flooding
3. Roles and Responsibilities clearly spelt out and agreed (no assumptions made by any organisation)
4. Clear and concise communication methods and information sharing
5. Details of all critical infrastructure and potential impacts if these are affected or impacted on by flooding

1. Training
2. Exercising
3. Information Sharing

1. The format should reflect the style of other local plans making it easier to use.
2. The plan should say if it is strategic or tactical and the content reflects the intended audience.
3. The plan should link with other plans that may be activated at the same time and the plans QA to ensure they do not clash.
4. Special consideration for vulnerable people should be included in tactical plans.

1. Relevant
2. Realistic
3. Comprehensible
4. Consistent
5. Up to date
1. Use of Pitt review recommendations
2. Multi Agency collaboration
3. Identification of key risks within the Geographical area
4. Effective action cards"

1. Brevity: Even if it means leaving information out, short plans are better because people might actually pick them up and read them. Nobody has time to read war and peace in an emergency.
2. Inclusivity: There are organisations who can provide valuable input and assistance who are not currently included in plans.
3. Simplicity: Don’t over complicate by trying to include everything. Critical infrastructure is the same or similar in any type of emergency, so have a separate critical infrastructure plan rather than making the flood plan bigger.

1. Outline of the flood risk areas

2. Specific responsibilities for response agencies
3. Command and Control arrangements
4. Arrangements for warning and informing the public
5. Trigger points and actions

1. Proper 'joined up' approach and formation of the plan.
2. Contribution by individual agency's reflecting what can be delivered.
3. A simple plan without great detail - signposting where further information is rather than including in the plan to make it a bulky, dust gathering, document.
4. Engagement through LRF to truly reflect and seek engagement from all stakeholders.

1. Keep the plan as brief / user friendly as possible
2. Signpost to specific plans held by individual organisations
3. Realistic
4. Clear roles and responsibilities

1. Sharing information and skills (e.g. certain agencies are better placed to access national databases, knowledge of flooding, map production etc than others)
2. User friendly terminology and structure - anyone from any agency should be able to pick up the plan and use it with no prior knowledge.
3. Structured e.g. from general principles applicable across an LRF area to specific locations and information.
4. National support to provide economies of scale - for example why does every LRF have to identify responsibility for disposal of carcasses? surely this could be addressed and issued in the guidance?
5. Standardisation between LRF boundaries - definite benefit should mutual aid be called upon."

Q11 If you have any further comments that you wish to make about tools, methods or guidance that you believe could contribute to improving Multi Agency Flood Plans please add them to the box below.

The flood warning area maps
Inundation and depth maps
Impacts on critical infrastructure and knock on effects to the community

The ability to run real time/forecast (so what scenario?) flooding areas and consequence animations would greatly benefit strategic and tactical commands.
Tools and guidance are of use; however, there comes a point when local information has to be collected and put into the plan.

The level of information required in the MAFP should be balanced against making a document too unwieldy (i.e. exercise/training information does not need to be included in an operational plan)

Clear and resilient communication paths for national, regional, area and local flood forecasting and response information.

In my experience during emergency flooding situations and training exercises taking the 'plan' off the shelf or out of the cupboard can be a bit of an afterthought. There needs to be a way of ensuring that all participants use the plan as this will provide continuity of approach and alleviate double handling of tasks.

The checklists should be less prescriptive, and allow for local knowledge/experience to be accounted for.
There should be a realisation that every eventuality cannot be planned for and generic response arrangements can be used by competent people to deal with situations.

Some areas have a much less risk of flooding so the detailed planning required by the checklists may not be proportionate.

Flooding is only one of a range of potential emergencies that we have to plan for

Flood Watches (soon to be Flood Alerts) and Flood Warnings need to explicitly state which area they refer to. Sometimes it can be confusing as to which these locations relate, especially for people who may be involved in the response to flooding but aren't involved in flooding work on a regular basis.

It would also be useful to have more information about the fluvial system across the region, not just our county. For example, flooding in Nottinghamshire is greatly influenced by the situation over the border in Derbyshire."

Clear, targeted information for emergency responders which triggers at a level that has impact for an appropriate response

Applicable to any incident, access to a single mapping tool for use by the partners to identify risks and threats within an area (vulnerable, critical sites etc) and to put key information - evacuation routes, rest centres Forward control points etc would improve the response

I feel there is a lack of guidance or consideration about exactly how the plan will be used in practise. If a County had a dozen communities experiencing flooding, how practical is the current layout in order to assist the commander in making decisions. There is great reluctance from utility companies to share data on assets and their vulnerability to flooding, partially because they do not have the information on their risk ('well it depends how much rain falls' etc), but mainly because they just don't see what the LRF would do with the information. They are concerned that stating a site is at risk will either result in the gold/silver command taking unilateral action without consulting them, or alternatively will put pressure on them to take action to reduce the risk before it floods. Either way, the benefits have yet to be fully explained, and thus the key infrastructure remains a struggle to obtain.

The DEFRA guidance and templates were excellent tools

I think there should be guidance on writing different levels of flood plans. In Staffordshire we used the national guidance for our Strategic plan, but we have had to create our own for Tactical level plans.
For an LRF MAFP there needs to be the 'power' available to ensure all represented organisations participate in its development and maintenance.

Clearer guidance on evacuation responsibilities would assist development of this section.

Who bears the costs of the development of this plan?

Flooding differs from many other emergencies in that clear decision making requires (especially in its early stages) a background understanding of the physical characteristics of the geographical area, integration of past lessons learned about where flooding occurs and understanding of the warnings and resources available via the Environment Agency. The key task of a MAFP is to give this data concisely, easily understood (charts, maps etc) - you cannot assume that all key officers will be at same standard regarding understanding and regarding the above. Once a situation occurs where evacuation etc may happen, it is important that the plan makes clear 'who does what' and again, gives clear indications of the agreed policy for dealing with this. It should not reiterate existing response plans - just highlight where flooding is different - e.g. refer to list of buildings available for use as holding areas (most Local Authorities have these) but use the flooding mapping to check they are not within flood outline - or similar wording.

I wish to restate my belief that tools, methods or guidance should be simple, without being simplistic, meaningful and appropriate.

My overall feeling is that the Environment Agency on a regional and local level could and should take a far stronger role as hands on facilitators of this work. They have far more experience of producing flood plans and responding to flooding than Local Authorities and this knowledge based on lessons learnt is not being utilised. The support from the Environment Agency is lacking at a local level- as a Local Authority Emergency Planning Unit we cover a number of local authority areas - if we want to use GIS we have to either approach each separate council to produce mapping products resulting in non-standard maps being incorporated into the plan or somehow try and synchronise data from all authorities into an in house GIS which then results in issues around data licensing particularly for populations/number of residences etc. The Environment Agency is far better skilled and resourced to undertake this work.

Appendix I Results of French survey

Table I1 Please indicate the level of usefulness of the following information, if it were available, in assisting you with the drawing of flood management plans (Q4)?

Percentage of responders for each "level" of usefulness	An assessment of potential injuries and loss of life for a range of flood scenarios	The "accessibility" of inundated roads ... for different scenarios	An assessment of potential damage to critical infrastructure	An assessment of the optimum location of shelters and rest areas	An assessment of other hazards triggered as the result of flooding	An assessment of the probability of buildings collapsing during a flood	An assessment of the optimal evacuation routes from the inundated area	An assessment of the time to evacuate people from areas at risk of flooding	An assessment of how improvements in the dissemination of flood warnings could reduce the risk to people	An assessment of the optimum location of shelters and rest areas
1 = "Not useful"	9%	3%	3%	3%	5%	6%	5%	4%	4%	6%
2	10%	0%	4%	4%	0%	10%	4%	4%	13%	4%
3	13%	3%	14%	13%	14%	**27%**	18%	12%	20%	22%
4	21%	12%	24%	34%	26%	25%	32%	25%	26%	22%
5 = "very useful"	**45%**	**83%**	**55%**	**37%**	**54%**	**27%**	**36%**	**54%**	**33%**	**43%**
0 = don't know	1%	0%	0%	9%	0%	4%	4%	1%	4%	3%

Table I2 **Please indicate what you believe is the most appropriate level of detail for the following information and data in flood emergency plans (Q6)?**

Percentage of responders for each "level" of detail	**Flood warning lead times**	**Flood map showing flood extent**	**Flood map showing depths, velocities and flow routes**	**Flood risk to people in terms of potential injuries and loss of life**	**Flood risk to properties**	**Impacts of floods on critical infrastructure**	**Evacuation routes and times**	**Potential for other hazards that may occur because of flooding**	**Shelters, rest areas and safe havens**	**Implementation of measures (e.g. sand bags, temporary defences)**	**Availability of the appropriate resources**
1 = Not detailed in the plan	0%	0%	0%	6%	6%	2%	3%	0%	3%	9%	1%
2	6%	0%	4%	16%	13%	5%	6%	9%	9%	7%	10%
3	16%	10%	10%	**28%**	30%	14%	26%	**37%**	15%	33%	13%
4	34%	28%	41%	25%	**36%**	38%	**35%**	26%	29%	**35%**	32%
5 = Very detailed	**40%**	**62%**	**45%**	22%	14%	**42%**	29%	26%	**44%**	13%	**43%**
0 = Don't know	4%	0%	0%	4%	0%	0%	0%	1%	0%	3%	0%

Table I3 **Please indicate what you believe is the most appropriate level of detail for the following issues related to communication, responsibilities and assumptions in flood management plans(Q7)?**

Percentage of responders for each "level" of detail	**Aims, objectives and assumptions of plan**	**Target audience of plan**	**Details of modifications to and updating of the plan**	**Plan activation (e.g. trigger levels etc)**	**Communication with other agencies**	**Communication with the public**	**Communication with the media**	**Relationship with complementary emergency management plans**	**Details of recovery**	**Training and exercises**
1 = Not detailed in the plan	3%	0%	4%	1%	3%	0%	4%	3%	7%	3%
2	6%	4%	21%	4%	6%	4%	10%	9%	18%	6%
3	**40%**	16%	**46%**	18%	**32%**	30%	**40%**	**34%**	**34%**	**49%**
4	30%	**49%**	22%	29%	32%	**33%**	25%	28%	31%	31%
5 = Very detailed	19%	30%	6%	**47%**	25%	**33**%	19%	26%	9%	12%
0 = Don't know	1%	0%	0%	0%	1%	0%	1%	0%	0%	0%

Appendix J Results of the Dutch survey

Table J1 Please indicate which level of detail following information and data in a Multi Agency Flood Plan should have?

Percentage of responders for each "level" of useful	**Potential injuries and loss of life for a range of flood scenarios**	**The accessibility of inundated roads to emergency services and other vehicles for different flood scenarios**	**Potential damage to critical infrastructure**	**The inter-dependencies between at risk critical infrastructure**	**Other hazards triggered as the result of flooding**	**Probability of buildings collapsing during a flood**	**Optimal evacuation routes from the inundated area**	**The time to evacuate people from areas at risk of flooding**	**How improvements in the dissemination of flood warnings could reduce the risk to people**	**Optimum location of shelters and rest areas**
Not useful	6.9%	6.7%	0.0%		0.0%	3.5%	0.0%	0.0%	0. 0%	0.0%
1 = Low level of detail	3. 5%	0.0%	0.0%		3.6%	13.8%	0.0%	0.0%	0.0%	3. 5%
2	10.3 %	13.3%	0.0%		7.1%	13.8%	3.3%	3.3%	13.8%	6.9%
3	17.2 %	16.7%	26.7 %		25.0 %	**34.5%**	16.7%	13.3%	24.1%	20.7%
4	**34.5 %**	13.3%	33.3 %		**39.3 %**	24.1%	26.7%	**26.7%**	20.7%	**41.4%**
5 = High level of detail	27.6 %	**46.7%**	**40.0 %**		25.0 %	6.9%	**53.3%**	56.7%	**34.5%**	27.6%
0 = Don't know	0.0%	3.3%	0.0%		0.0%	3.5%	0.00%	0.00%	6.90%	0.00%

Percentage of responders for each "level" of useful	**Prediction times**	**Size of flood area**	**Water depth, flow velocities and VERLOOP of flood**	**Potential damage maps**	**Risk maps**	**Effect of the appliance of measures (temporal levees, sand bags)**	**Availability of resources**
Not very useful	0.00%	0.00%	0.00%	6.90%	0.00%	0.00%	0.00%
1 = Low level of detail	0.00%	0.00%	0.00%	6.90%	3.57%	3.33%	3.45%
2	3.33%	0.00%	0.00%	13.79%	3.57%	13.33%	6.90%
3	10.00%	13.33%	10.34%	**34.48%**	25.00%	20.00%	**31.03%**
4	33.33%	36.67%	**55.17%**	24.14%	**46.43%**	**30.00%**	17.24%
5 = High level of detail	**53.33%**	**50.00%**	34.48%	13.79%	21.43%	**30.00%**	**31.03%**
0 = Do not know	0.00%	0.00%	0.00%	0.00%	0.00%	3.33%	10.34%

88% of the responders said that if they had the above information available to them, it would be useful.

- Generally, a higher level of detail is thought to be necessary for a MAFP.
- For the probability of buildings collapsing during a flood, potential damage maps and the availability of resources, a relatively low level of detail is assumed to be needed.
- For optimal evacuation routes from the inundated area, prediction times and the size of the flood area, the scores were most unanimous. Also, the highest level of detail is assumed to be needed for this information.

Q6: Is there other information that is used within your area or that you feel is a need for, and that is not yet mentioned in this list?

Status of the levees
Good overview of the (actual) strength of the levees
Insecurities of the forecasts of water levels and level of threat
Effect of public accessible information on the behaviour of the public
Overview of energy providers with an area overview of where they are active
Overview of drinking water providers with an area overview of where they are active
Overview of usable roads (estimation) after a flood (per worst credible flood scenario)
Number of inhabitants
Environmental effects that are flood specific (galvanisation companies can be a threat)
Vital objects such as the objects from KLPD, RIVM, KNMI, RWS, etc.
Uniform methods for determination of the shelter capacity for refugees in municipal locations.
For people that can (hardly) save themselves during a flood, no useful standard exists for shelter and care.
Definition of Herkomstgebieden and Bestemmingsgebieden (??)
National plans are unclear
The safety regions at this point can not say much about evacuation routes and shelter, because this is regulated on a higher level. The ministries however do expect that the regions can say something about this, although their plans are far from final.

Information from crisis partners
Integrality between the (sub)plans of several (bordering) regions and multidisciplinary components.
National developments with regard to larger scale floods like the National Draaiboek (??) for Floods
Organization and coordination of cooperation aid providing organizations and governments
Disaster management plans of the waterboards are not mentioned as a separate category in this survey

Communication, responsibilities and assumptions

Please indicate what you believe is the most appropriate level of detail for the following information and data in a Multi Agency Flood Plan?

Current usage of tools to inform Multi-Agency Flood Plans (% of responders)	**Aims and assumptions**	**Target audience**	**Planning of update and version management**	**Plan activation**	**Communication with other agencies**	**Public information**	**Communication with media and media watching**
1 = low level of detail	0.00%	0.00%	5.00%	0.00%	0.00%	0.00%	4.76%
	20.00%	0.00%	10.00%	5.00%	0.00%	4.55%	0.00%
	30.00%	40.00%	**45.00%**	10.00%	9.09%	27.27%	19.05%
	45.00%	**50.00%**	25.00%	30.00%	**50.00%**	**36.36%**	**42.86%**
5 = high level of detail	5.00%	10.00%	15.00%	**55.00%**	40.91%	31.82%	33.33%
0 = no opinion	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Current usage of tools to inform Multi-Agency Flood Plans (% of responders)	**Relationship with complementary emergency plans**	**Recovery**	**Training and exercises**	**Organisation (responsibilities and command)**	**Action plans, e.g. evacuation**	**People and resources**	**Reporting / evaluation of event**	**Flooding scenarios and uncertainty**
1 = low level of detail	4.55%	9.52%	4.76%	0.00%	0.00%	0.00 %	9.09 %	4.76%
	0.00%	9.52%	19.05%	0.00%	13.64%	14.29 %	9.09 %	4.76%
	36.36%	28.57%	19.05%	9.09%	27.27%	23.81 %	**40.9 1%**	19.05 %
	50.00%	**47.62%**	**33.33%**	36.36%	**31.82%**	**52.38 %**	27.2 7%	33.33 %
5 = high level of detail	9.09%	0.00%	19.05%	**54.55%**	27.27%	9.52 %	13.6 4%	**38.10 %**
0 = no opinion	0.00%	4.76%	4.76%	0.00%	0.00%	0.00 %	0.00 %	0.00%

- Generally, a higher level of detail is thought to be necessary for a MAFP.
- For planning of update and version management of the plan and for reporting and evaluation of the event, a relatively low level of detail is assumed to be needed.

- For plan activation, organisation and people and resources, the scores were most unanimous. These are also the metrics that scored in general the highest in the Dutch disaster management plans.

Effectiveness of Flood Plans

The Netherlands
Organisation, command, responsibility
Responsibilities well defined in the plan
Communication between involved parties well described
Clear command structure
Upscaling of the plan is clear
Command structure for making plans and execution of the plans clear
Clearly define roles and tasks of involved parties
Cooperation of involved parties during the construction of a plan
Clear command structure
Well organized communication
Communication
Synchronization between involved parties, other regions and ministries
Clear time lines
Organisation
Synchronization between involved organizations
Coordination of synchronization between responsible authorities
Clearly defined actions

Information/knowledge
Different scenarios available
Insight in inundation (velocity, water depth, flow velocities)
Insight in chain effect areas
Illustrative: get a good understanding of the threat
Reliable prediction

Insight in evacuation possibilities
Insight in shelter possibilities
Zicht op redden (???)
Focus on safety
Focused on the creation of boundary conditions for the ability of the population to save itself

Focus on measures for the preservation of economy and infrastructure
Perspectives for action taking (handelingsperspectief)

Focused on specific areas

Information availability during event
How quickly the (most recent) information can be delivered
Information supply/information systems
Netcentric working (??)

Readability and accesibility
The plan must be readable and it must be quickly consultable
Accesible
Kept in a logical place
Simplicity/clarity
Concise

Training
Exercise, training and education
Exercise of the plan
Plan must be well known (bekendheid)
How well the disaster plan is trained with

Decision making
Criteria on which the decision making process is based
Correct information on which decisions can be based

Up to date
Up to date (actualiteit)
Up to date

Communication
Communication to the public well described
Communication plan

Other
Attention for prevention
Connection between relevant plans/functional columns (functionele kolommen)
Implementation in the involved organizations
Prompt and reliable warning
Useful under other disaster conditions

CRUE
FLOODING ERA-NET

Integrate, Consolidate and Disseminate
European Flood Risk Management Research

Research supported by the
2nd ERA-NET CRUE Funding Initiative for Research in Flood Risk Management







Flood resilient communities – managing the consequences of flooding

ANNEX B TO THE FIM FRAME FINAL REPORT

CRUE Research Report No 2: Flood Incident Management – A FRAMEwork for improvement – FIM FRAME

Comparison of currently available tools and enabling technologies for the emergency planning of floods

Prepared by the Joint Project Consortium consisting of

Project partner #1, HR Wallingford, UK

Project partner #2, Deltares, The Netherlands

Project partner #3, Laboratoire Central Des Pont Et Chaussées, France

Project partner #4, University Montpellier III, France

CRUE Co-ordinator: John Goudie (Defra)
Project Contract No: ERAC-CT-2004-515742
Project Website: www.crue-eranet.net

DISCLAIMER

Flood Incident Management – A FRAMEwork for improvement

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
The Effectiveness and Robustness of Emergency Plans for Floods

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Flood resilient communities – managing the consequences of flooding

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
Comparison of currently available tools and enabling technologies for the emergency planning of floods

CRUE Research Report No I-2

Prepared by

Project partner #1, HR Wallingford, UK

Project partner #2, Deltares, The Netherlands Name of Research unit

Project partner #3, Laboratoire Central Des Pont Et Chaussées, France

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Summary

This report has been produced as part of Work Package 2 (WP2) of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME). The report provides an overview of tools that are available to assist with providing information for emergency plans for floods. As part of WP2 research flood managers were consulted to assess what tools they currently use and also to assess which tools they perceive to be useful.

From the research carried out many flood managers are often not aware of the tools that are available to assist them in providing information to emergency plans for floods. Based response of flood managers in the three countries, the two main obstacles to tools not being used appear to be:

1. Lack of awareness of the methods that are available
2. Availability of data

In formulating emergency plans for floods it would appear that “expert judgement” is often used rather than specific tools. Many responders to the survey mentioned that they used a combination of information rather than specific methods or tools. For example in the survey in England and Wales around half to a third of the responders stated that they were aware of or used the following methods to inform Multi-Agency Flood Plans (MAFPs):

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

However, none of the 44 responders who are involved in providing information to assist with the formulation of MAFPs explicitly mentioned any methods or tools that provide such information.

In France the awareness level of the tools and methods available would appear to be lower than that in England and Wales and the Netherlands. The lack of awareness in general may be as a result of a need to improve the dissemination of the tools and the relevant research. The lack of awareness of tools to assess the consequences of flooding or to assess potential damage has already been pointed out in many articles and reports in France.

In all three countries there would appear to be a requirement for some form of guidance on what tools are available, what data they require and how they can be implemented to give information that can be used to improve emergency plans for floods.

Contents

1 Introduction

1.1 Background to the research

This report has been produced as part of Work Package 2 (WP2) of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME).

FIM FRAME is a 24 month project research project. The project is funded by

- The joint Department for Environment, Food and Rural Affairs (Defra)/Environment Agency Flood And Coastal Erosion Risk Management (FCERM) Research and Development Programme and
- The Ministère de l'Ecologie, de l'Energie, du Développement Durable et de la Mer, en charge des Technologies Vertes et des Négociations sur le Climat (MEEDDM).

The research is being undertaken in the UK, France and the Netherlands. The project partners are:

- HR Wallingford, UK – Project coordinators
- Deltares, The Netherlands
- Gestion des Sociétés, des Territoires et des Risques (GESTER), University of Montpellier III, France
- Laboratoire Central des Ponts et Chaussées (LCPC), Nantes, France.

The objectives of the research can be summarised as follows:

- To assess the "effectiveness" of a sample of current flood emergency plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved;
- To evaluate the current tools and technical systems that are used to inform flood emergency plans and the ability of these tools to support future flood event emergency planning with the main aim of reducing residual risk (i.e. primarily loss of life);
- To establish how currently available tools (e.g. guidelines, models) can be used to improve emergency management plans for floods and whether there are any gaps in the tools that are available;
- To provide a framework by which flood incident management can be improved that will be tested in a number of case studies.

The research has been carried out in six Work Packages (WPs) as follows:

- WP1 - Effectiveness and robustness of flood event management plans
- WP2 - Comparison of currently available tools for the emergency planning of floods
- WP3 - Development of framework to improve flood event management
- WP4 - Case studies utilising the developed framework to improve emergency plans working together with emergency responders, emergency planners and other stakeholders
- WP5 - Dissemination of the results
- WP6 - Management and coordination.

The relationship between the six Work Packages is shown in Figure 1.1.

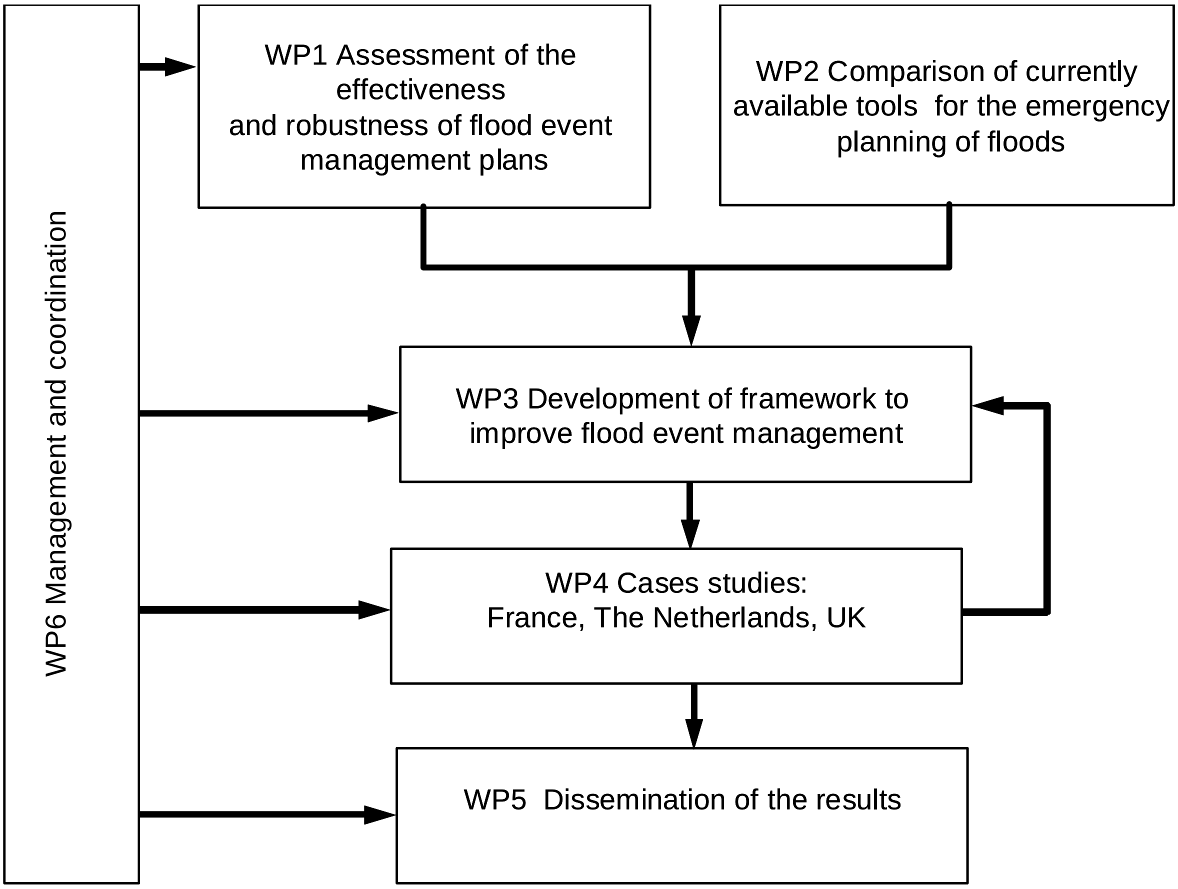


Figure 1.1 Relationship between the FIM FRAME Work Packages

1.2 Structure of the report

This report has been structured as follows:

- Chapter 1 provides background to the objectives of the research and this report;
- Chapter 2 gives a review of tools and methods that could be used to improve the emergency planning for floods that are available in England and Wales, France and the Netherlands;
- Chapter 3 summaries the output from a survey of flood managers in the three countries;
- Chapter 4 brings out the conclusions of the report;
- Chapter 5 details the references used to compile the report.

1.3 Background to Work Package 2 (WP2) of FIM FRAME

The principal emphasis in the development of any flood emergency plan should be on the response to the flood incident and not the cause of the incident. In many locations there are an infinite number of possible flood scenarios and it is impossible to plan for them all. By concentrating on planning to deal with outcomes, it is possible to respond to a very large range of flood events within the framework of a limited number of plans. Such plans need to be flexible: to allow for all weathers and times of day/night, to work when key people are on holiday and to be usable even when the outcomes of an incident have unexpected complications.

Any flood emergency plan must be tested to ensure that it encompasses the outcomes of all known or reasonably foreseeable risks and that it would be effective in providing a sufficient and timely response. At present, this is normally done through table top exercises or in some cases full-scale live exercises of a response. Both these approaches, although useful have their limitations in terms of cost, time and the number of scenarios that can be undertaken. At present, tools such as emergency planning software are rarely used in either flood event planning exercises or to improve the effectiveness of these plans.

The output of this Work Package (WP), together with the results of WP1 and the research undertaken with the stakeholders in each country, will provide the research team with a sound basis to answer the following questions:

- Are the tools being used and if so are the effective in improving the response to flood events?
- How do these tools address the problems emergency planners face and can the tools be improved?
- How can these tools be used in practice to reduce the residual risk from floods especially the loss of life?
- Can the output from these tools be used to improve the coordination between different emergency responders?

As part of WP3, the metrics developed in WP1 to assess flood emergency plans will be mapped to the available tools. The purpose of this mapping process is to highlight the following:

- Where tools that are not currently being used can improve flood event management plans;
- Where there are no appropriate tools available;
- Where tools need to be improved.

The objective of this mapping process will inform the development of a framework to improve the emergency planning for floods that will be developed as part of WP3.

2 Review and assessment of tools

2.1 Introduction

This section provides a brief review of tools that are available in the three project areas and that are also used in other parts of the world. The tools reviewed fall into the following categories:

- Guidelines and checklists;
- Flood hazard mapping tools;
- Tools related to assessing the risk to people, vehicles, evacuations times and safe havens.

2.2 Guidelines and checklists

2.2.1 *Preliminary guidance for developing a Multi-Agency Flood Plan, England and Wales*

The objective of the guidance is to assist Local Development Forums in England and Wales to develop Multi-Agency Flood Plans (MAFP). The 43 page guidance provides examples of the information that should be included in a MAFP and also how the MAFP should be structured. The guidance covers:

- Aim and objectives of the plan;
- Ownership and audience;
- The risk of flooding;
- Related and interdependent plans;
- Communication plan;
- Plan activation – Thresholds and triggers;
- Actions, roles and responsibilities;
- Vulnerable people;
- Key infrastructure;
- Evacuation and sheltering of people;
- Recovery;
- Training and exercising.

2.2.2 *Checklist for a Multi-Agency Flood Plan, England and Wales*

The checklist was developed so that a consistent method for assessment can be applied. It can be used as a discussion tool with LRFs and to provide an audit trail to show how an assessment status of "satisfactory" or otherwise of a Multi-Agency Flood Plan was derived. The checklist includes a suggested scoring system. The MAFPs are scored out of a possible 565 points and are rated as follows:

- 81% to 100%   Very satisfactory

- 61% to 80% Satisfactory
- 41% to 60% Average
- 21% to 40% Unsatisfactory
- 0% to 20% Very unsatisfactory

2.2.3 Guide ORSEC Départemental - Méthode générale, France

The Guide Orsec Départemental - Méthode générale was produced to assist in producing emergency plans in France. ORSEC plans are aimed at the Départmental level in France. This guidance comprises a 73 page document to help planners put these plans together.

2.2.4 Plan Communal de Sauvegarde - Guide pratique d'élaboration, France

The “Plan Communal de Sauvegarde - Guide pratique d'élaboration” is 200 page guidance document put together to help prepare community level emergency plans that cover all natural hazards. The document contains checklists, flowcharts, details of technical tools as well as examples to help community leaders put together plans. The document is freely available via the internet. The document appears to be widely used in France to assist emergency planners in putting local level emergency plans together.

2.2.5 Plan Communal de Sauvegarde (PCS) “S’organiser pour être prêt” La Démarche, France

This 42 page document details the process for putting together a PCS. The document is freely available on the internet. The document outlines the following:

- The main principles for putting together a PCS;
- Guidance on the level of detail that is required in a PCS;
- Information on which actors should be involved and the level of support;
- The legal background and documents relevant to PCSs.

2.2.6 Plan Communal de Sauvegarde PCS “S’entraîner pour être prêt” Les Exercices, France

This 88 page document, freely available from the internet, provides information on how to conduct training exercises for PCS. It covers:

- The principles of the exercises including: the possible types; stages; how to prepare for the exercise and what the objectives should be;
- How to prepare for the training exercise;
- What can be learnt from the experience;
- A numbers of cases studies and examples including ones that are related to flooding.

2.2.7 *Prévenir et gérer les risques naturels au niveau local pour le développement durable des territoires - Guide à l'usage du maire et des élus - Rhône-Alpes, France*

This document is specifically aimed at the Rhône-Alpes region of France; it is a 42 page document that is freely downloadable from the internet. Its focus is related to how local communes in the Rhône-Alpes region can identify natural hazards although it does link to the Plan Communal de Sauvegarde that are often based on these assessments.

2.2.8 *Inventory of the resource requirements for emergency management, The Netherlands*

The inventory of resources requirements for emergency management – 'Leidraad Maatramp' (LMR) was produced by the Dutch Ministry of Inland Affairs. It provides a method to assist emergency responders in determining the required resources to deal with a particular type of emergency or hazard. Eighteen types of hazards are identified including flooding. For each hazard, five scenarios are defined of which one is selected as the standard scenario. For this scenario the required resources are determined. This gives an indication as to which type of emergency requires the most resources. The tool focus is to help produce plans and in the training and education of managers of the different organisations involved in emergency management. Figure 2.1 gives a typical output from the tool. There are also spreadsheets available as part of the tool to help assess the resource capacity.

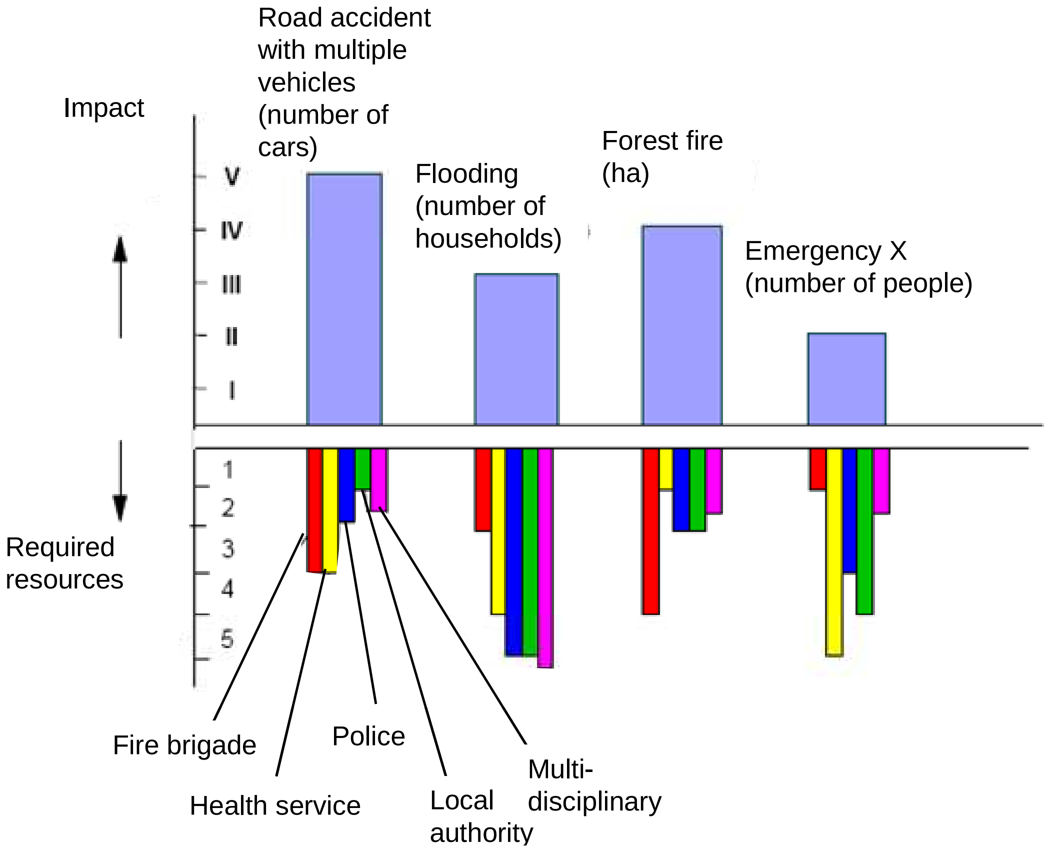


Figure 2.1 **Inventory of resource requirements for emergency management – 'Leidraad Maatramp' (LMR)**

2.2.9 Regional model for disaster planning, The Netherlands

This guidance provides a format for regional disaster planning. The format was produced by the Haaglanden Safety Region. The format was developed to provide a model for event planning. It focuses on all types of disaster that can occur on a regional scale. It provides predefined chapters and contains definitions, background information and explanation and descriptions of aspects which are generally agreed upon e.g. processes, responsibilities at certain emergency levels. Region specific information needs to be filled in. However, it is not obligatory to follow this format in the Netherlands.

2.2.10 Framework for evaluation of task execution of Safety region (RADAR), The Netherlands

The framework for the evaluation of Safety Region event management (RADAR, RAmpenbestrijding Doorlichtings ARrangement) is an instrument for evaluating the state of event management implementation in The Netherlands. It defines the criteria that event management should comply with. The criteria are divided into subjects such as: organisation, alerting, upgrading and information management.

2.2.11 Quality criteria for the production of municipal event plans (Besluit kwaliteitscriteria planvorming rampenbestrijding), The Netherlands

The objective of this tool is to establish criteria for event planning. The statutory regulations describe the criteria which a municipal event plan should comply with. These plans are of a general nature and do not specifically deal with flood risk.

2.3 Flood hazard mapping tools

2.3.1 Introduction

There are numerous flood hazard mapping tools and models available. The results of the surveys of flood managers have indicated that there is a high degree of awareness amongst flood managers regarding the tools that are available for mapping the flood hazard. It is not the intention of this report to repeat the large volume of information that already exists on flood hazard mapping tools. In the past decade the use of two dimensional hydraulic models has become increasingly prevalent meaning that it is now easier than ever to produce flood hazard maps that show not only flood extent but depth, velocity or a combination of these two parameters. Two dimensional hydraulic models include Flo-2D, InfoWorks RS 2D; Mike 21; Sobek; Telemac 2D and TuFLOW. Typical outputs in terms of maximum flood depth and velocity maps are shown in Figures 2.2, 2.3 and 2.4.

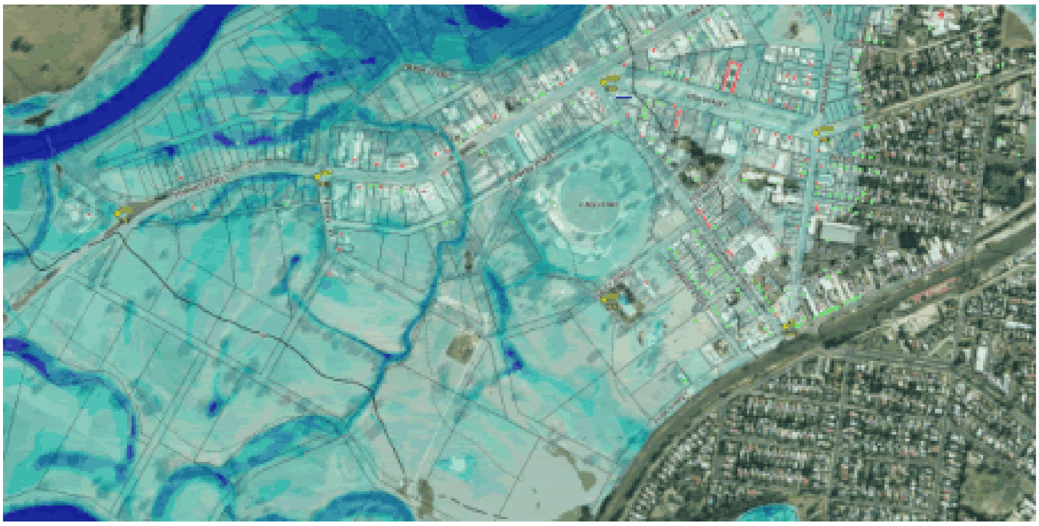


Figure 2.2 A flood map from the UK showing flood depth as well as extent which represents a typical output from a piece of two dimensional hydraulic model

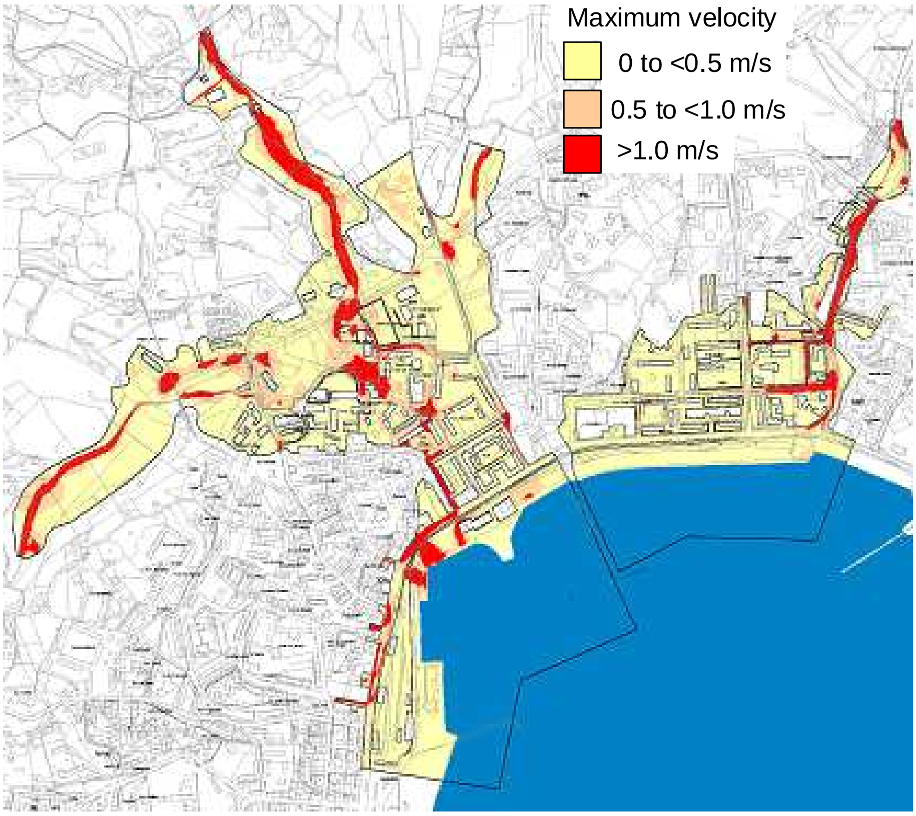
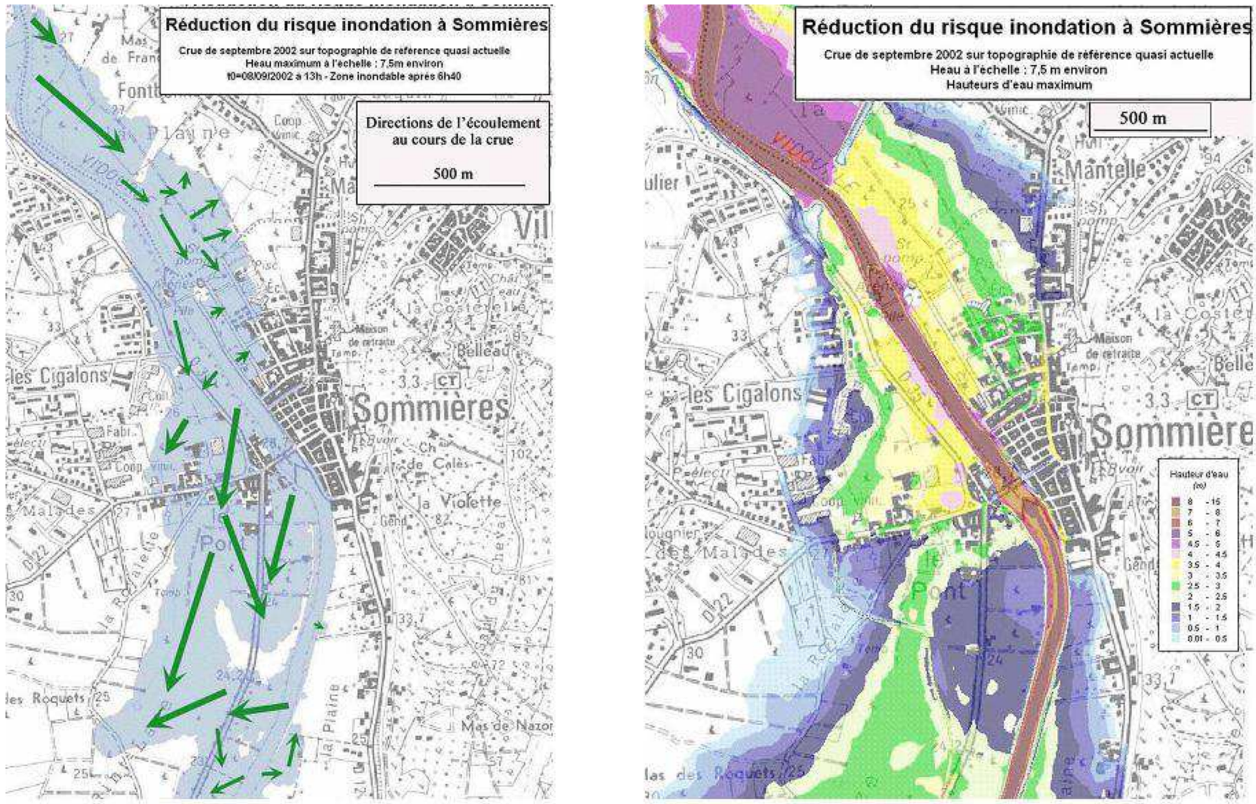


Figure 2.3 A map for an urban area in France showing maximum flood velocities for the 1 in 100 year flood produced using a two dimensional hydraulic model used in emergency planning



Path of the water during the 2002 flood

Water depth when a level of 6.5 m is reached at the gauging station

Figure 2.4 **Examples of flood maps showing flow paths and flood depths used in emergency plans for Sommières in France**

2.3.2 Environment Agency Flood Map, England and Wales

The Environment Agency in England has developed flood extent maps. These maps show the flood extent for the “undefended scenario” (i.e. assuming that there are no flood defences in place). There is a process whereby these maps are continually updated. For fluvial floods the maps show the maximum undefended flood extent for the 1 in 100 and 1 in 1,000 year return period. For coastal flooding the undefended flood extents for the 1 in 200 and 1 in 1,000 year return periods are shown. These maps also show Flood Zones as follow:

- **Flood Zone 1** - This zone has a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%) – classified by the Environment Agency as a “low probability zone”;
- **Flood Zone 2** - This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% to 0.1%) in any year. – classified by the Environment Agency as a “medium probability zone”;
- **Flood Zone 3a** - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year – classified by the Environment Agency as a “high probability zone”;
- **Flood Zone 3b** - This zone comprises land where water has to flow or be stored in times of flood, this is often defined as land which would flood with an annual probability of 1 in 20 (5%)

or greater in any year– classified by the Environment Agency as a “high probability zone – functional floodplain”.

An example of the Environment Agency’s flood map is shown in Figure 2.5.

Figure 2.5 Example of the Environment Agency Flood Map in the vicinity of Oxford

2.3.3 Environment Agency Surface Water Flood Map, England and Wales

The surface water flood maps were produced to provide an initial indication of areas that may be susceptible to surface water flooding, for use in their functions which relate to emergencies as defined and as required by the Civil Contingencies Act 2004 in England and Wales. The maps show susceptibility to surface water flooding where this is defined as “*flood event that results from rainfall generated overland flow before the runoff enters any watercourse or sewer*”. It is usually associated with high intensity rainfall (typically >30mm/hour) resulting in overland flow and ponding in depressions in the topography, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability. Urban underground sewerage/drainage systems and surface watercourses may be completely overwhelmed, preventing drainage. Surface water flooding does not include sewer surcharge in isolation. A typical example of the surface water flood map is shown in Figure 2.6.

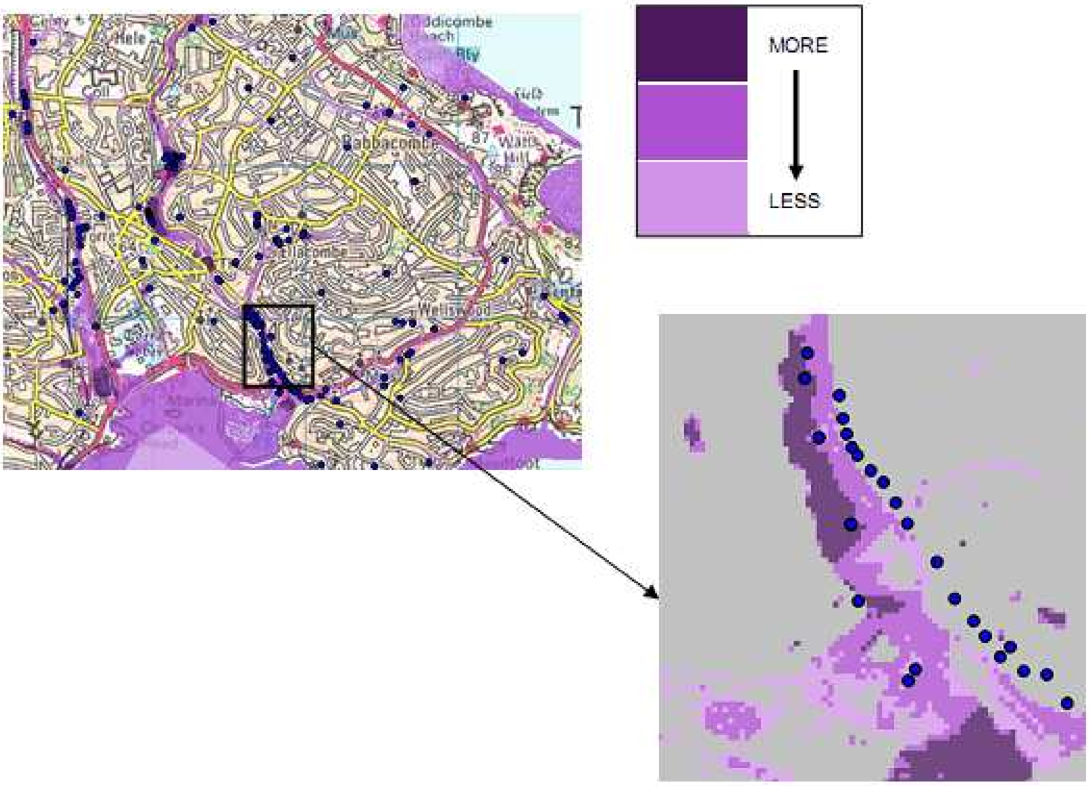


Figure 2.6 **Example of the Environment Agency Surface Water Flood Map in the town of Torquay in the south-west of England**

2.3.4 Environment Agency Reservoir Inundation Maps (RIM), England and Wales

The Environment Agency has produced inundation maps for all of the 2,092 large raised reservoirs that they regulate under the Reservoirs Act 1975. These inundation maps show the effects on the downstream catchment of a dam breach. Top-tier local authorities will use these maps to manage the development of emergency flood plans with their Local Resilience Forum (LRF). These plans will be followed in the event of a dam breach.

2.3.5 OSIRIS Inondation, France

The software called "OSIRIS Inondation" is a tool that has been developed to help Communes and the emergency managers in France to prepare their flood protection plans (Plan de Sauvegarde Inondation). It provides details of inundation levels, as shown in Figure 2.7; however, it also acts as an emergency management tool. The use of this software helps to simplify the production and updating of these plans. The software was developed by the Loire Département, in partnership with the Centre of Maritime and River Technical studies (CETMEF). The main objectives of the tool are:

- To provide a framework and a tool support to help decision makers and local stakeholders to prepare their local emergency management plans (PCSs)

- To disseminate flood forecasts and to establish a link with emergency management
- To help involve all the relevant actors in the process of prevention and management of the floods
- To facilitate the communication between the various levels of management and responsibility of the actors involved in emergency planning
- To provide a freely available tool to help emergency planners assess floods.

The tool also provides details of the action required for a particular level of hazard. This is shown in Figure 2.8. This tool does not seem to be particularly widely used in France.

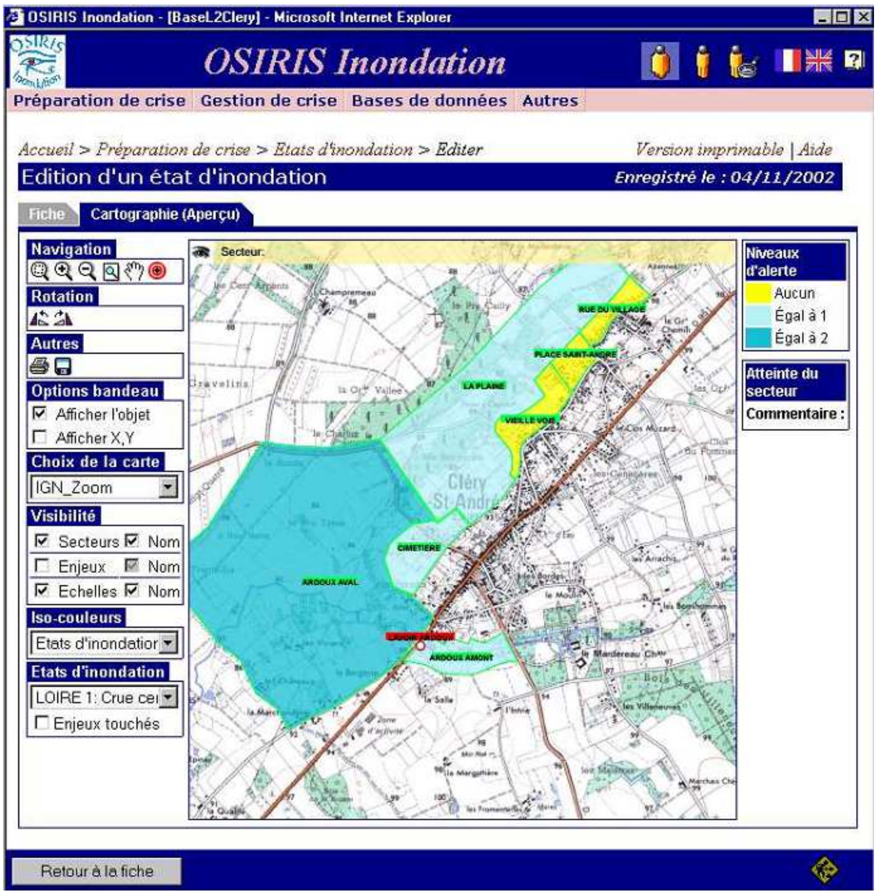


Figure 2.7 Example of an output from the OSIRIS Inondation tool showing different levels of flood inundation

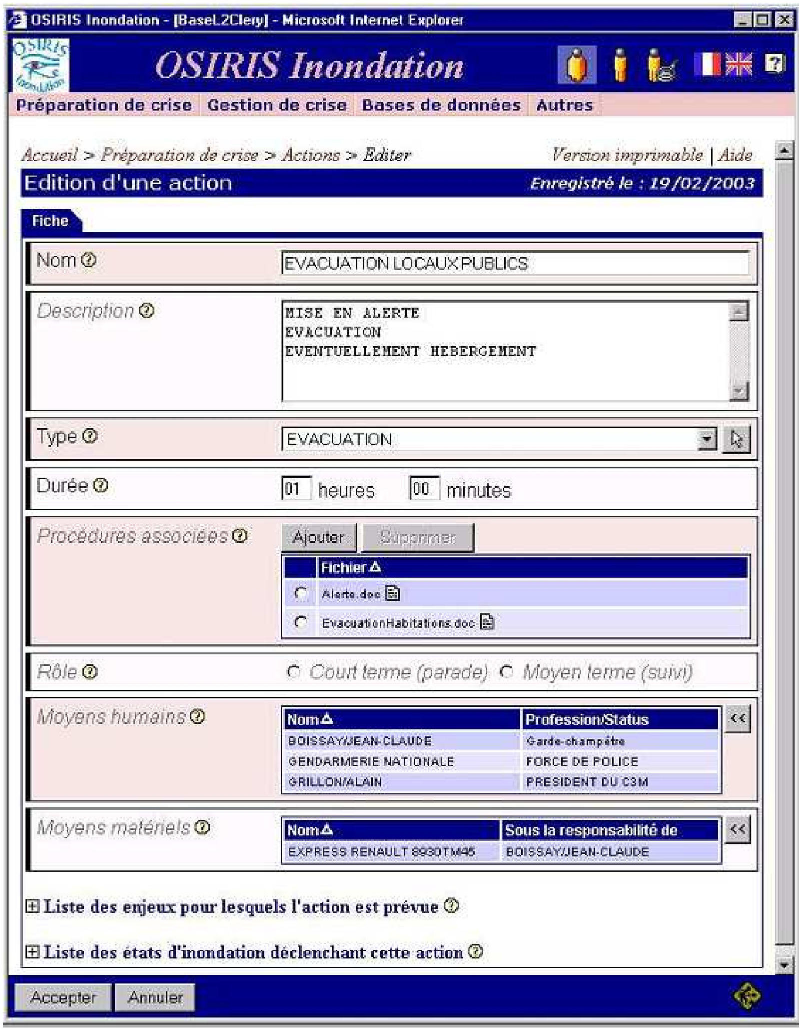


Figure 2.8 **Example of an output from the OSIRIS Inondation tool showing the action required for a particular level of flood hazard**

2.3.6 LIZARD-flooding, The Netherlands

The LIZARD-flooding system is based on the Flood Early Warning System (Delft-FEWS) software that provides base operations for water management in The Netherlands. The internet based system, which can be used by municipalities, regional water boards and the national water board contains over 5,000 nation-wide flood scenarios, and over 200 flood models.

The software has a module for the management, viewing and comparison of flood model scenarios and results. It is a web based information system with a central database containing many flood simulation scenarios including flood extents, water depths, water velocities, land use, damage, accessibility or roads and numbers of causalities. The tool can be used to gain an insight in the effects of different flood scenarios for the Netherlands and provide the basis for strategic and operational choices. Figure 2.9 shows an example of Lizard-flooding showing flood water depths.

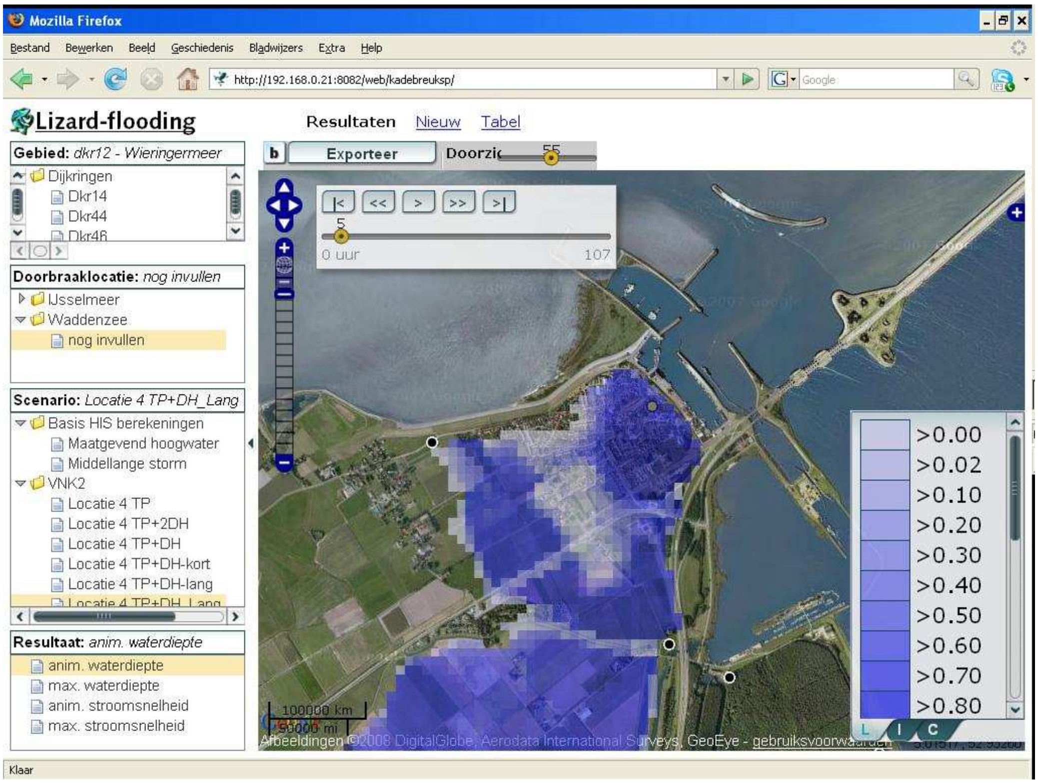


Figure 2.9 Example of the Lizard-flooding software flood depth map

2.4 Tools related to assessing the risk to people and vehicles, evacuation times and safe havens

2.4.1 Risk to people method, England and Wales

The objective of the Risks to People method is to provide a simple method for assessing and mapping the risk of death or serious harm to people caused by flooding. Two of the stakeholder requirements that were identified as part of the project were to:

- Provide guidance on identifying areas of high flood risk to people at a local scale which is needed for Local Authority emergency plans. Guidance should be based on local data where possible.
- As long as detailed information on flood velocity and depth are available, provide a method via which maps could be produced highlighting the most "at risk" people, areas of danger for people and vehicles and safe access and exit routes.

The method requires the following:

- The flood hazard defined by the flow depth and velocity
- The area vulnerability which depends on the nature of the area (including types of buildings), availability of flood warnings and speed of onset of a flood

- The people vulnerability which depends on the age and physical condition of the people exposed to a flood.

Figures 2.10 and 2.11 provide details of the outputs from these methods.

d x (v + 0.5)	Degree of flood hazard	Description
<0.75	Low	Caution *"Flood zone with shallow flowing water or deep standing water"*
0.75 - 1.25	Moderate	Dangerous for some (i.e. children) *"Danger: Flood zone with deep or fast flowing water"*
1.25 - 2.5	Significant	Dangerous for most people *"Danger: flood zone with deep fast flowing water"*
>2.5	Extreme	Dangerous for all *"Extreme danger: flood zone with deep fast flowing water"*

Where d = depth of the floodwater and v = velocity of the floodwater

Figure 2.10 Output of the Risk to People project showing the degree of flood hazard

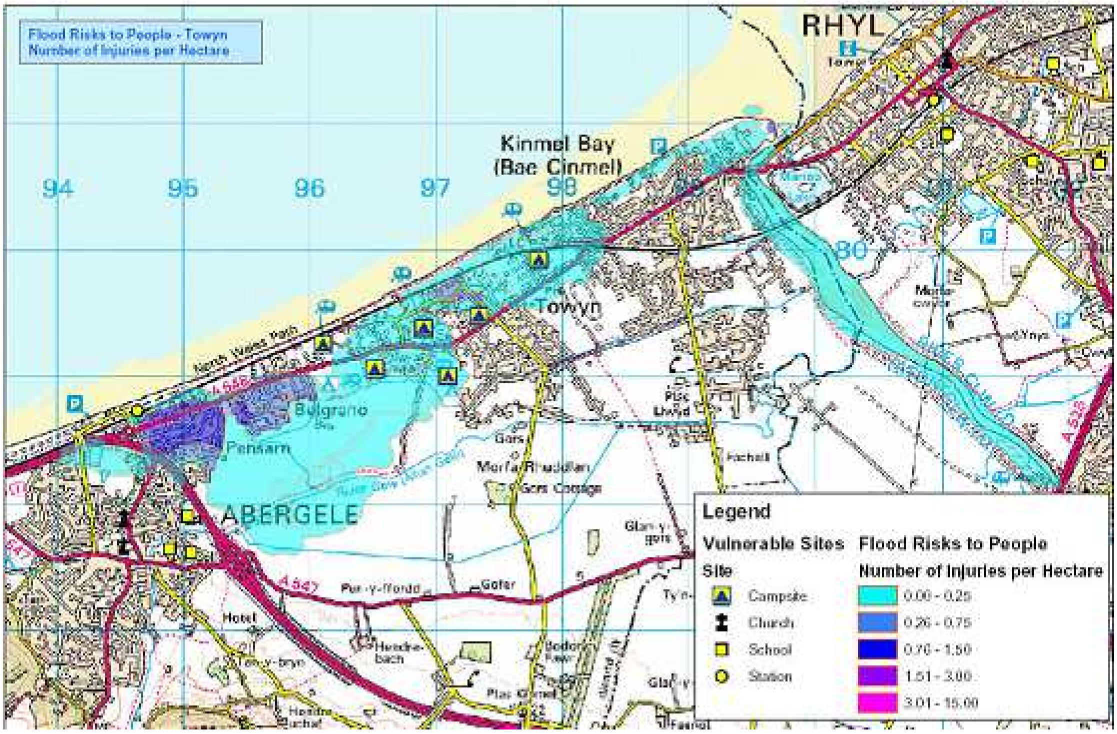


Figure 2.11 Output of the Risk to People project map showing the expected number of injuries per hectare for a breach of the flood defences in north Wales

2.4.2 LIFESim, USA

LIFESim is a spatially-distributed simulation modelling system for estimating potential life loss developed by the University of Utah in the USA. It allows potential loss of life during a flood event to be estimated based on the loss of shelter; building collapse and evacuation time.

LIFESim can be used for dam safety risk assessment and by dam owners and local authority emergency managers to explore options for improving the effectiveness of emergency planning and response. Development of LIFESim has been sponsored by the US Army Corps of Engineers and the Australian National Committee on Large Dams (ANCOLD). A typical output for LIFESim is given Figure 2.12, which shows the projected loss of life for an embayment in New Orleans with an increase in water level in the embayment.

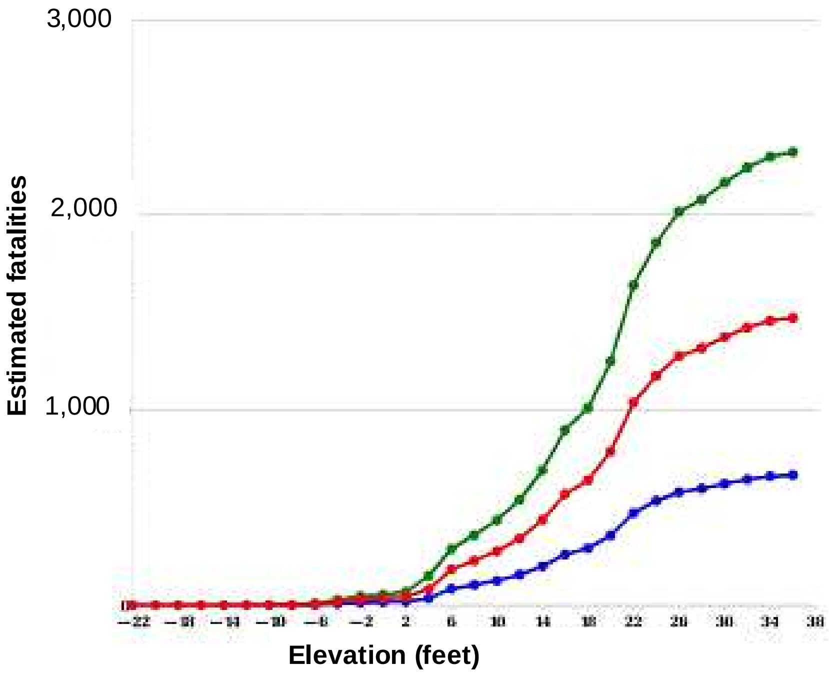


Figure 2.12 Output from LIFESim showing the increase in estimated fatalities in New Orleans with an increase in water level

2.4.3 Outil d'aide à la gestion des risques et des crises (OGERIC), France

The Outils d'aide à la gestion des risques et des crises (OGERIC) is a French tool to assist with the management of risk and emergencies. The tool was developed in 2009by the Centre d'Etudes Techniques de l'Equipement Mediterranée to help emergency management services to handle their GIS data during emergencies. OGERIC allows emergency managers:

- To display all the events in a GIS
- To locate and follow the outcome of the events
- To cross reference other databases
- To display geographical layers such as road network and floodplains
- To have an overview of elements useful for decision making

The OGERIC allows post emergency evaluation to be carried out more easily and links to key databases. During an emergency the operator of the system can map events and this information is available to emergency responders as events unfold. Various actors can contribute information to the system. The tool acts as an interface to display more easily GIS information. However, it does not bring any response on specific items such as the assessment of the accessibility of inundated roads or other risks. A typical screen from the tool is shown in Figure 2.13.

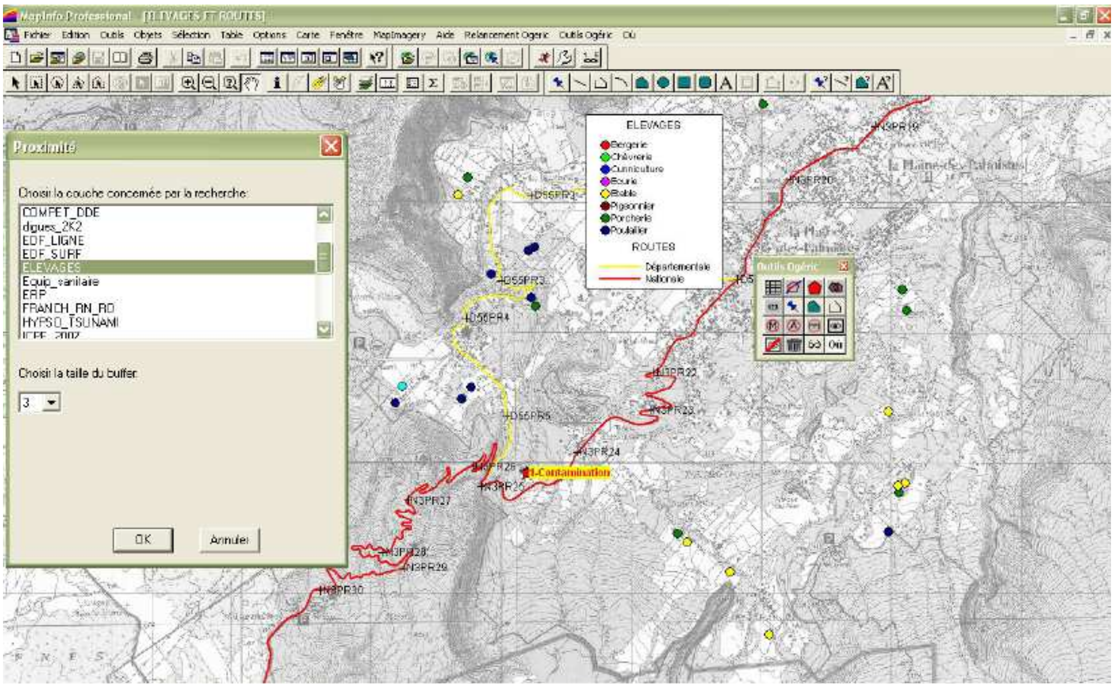


Figure 2.13 Example of work process of the OGERIC tool

2.4.4 National evacuation Module (LEM), The Netherlands

The objective of the Tool is to support the planning, exercise, evaluation and monitoring for a large scale evacuation event. The tool was produced by the Dutch National Water Board. It comprises three modules; planning, training and monitoring. The planning module focuses on preparing for an evacuation event. The training module is used for multi actor training purposes and the monitoring module is applied to monitor the actual event in comparison to the scenario on which the plan is based. By monitoring one can adjust the planned operations to the actual event using the original plan as a basis. The underlying software is OmniTrans for calculation of traffic, and Spoel for evacuation simulation process in time. Different scenarios can be evaluated. The module takes account of the behavior of people, shelter areas, location of vulnerable groups of people and road capacity during the event. A vulnerability assessment of the scenarios can be performed as well. Figure 2.14 gives an example of the work process in the LEM software.

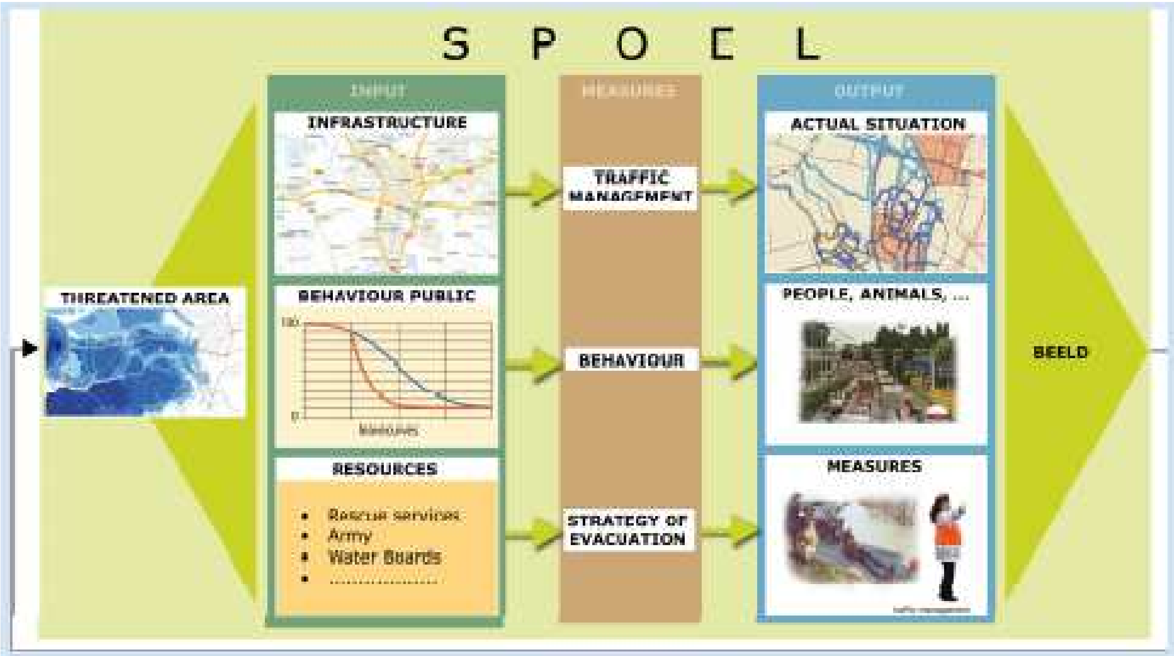


Figure 2.14 Example of work process of the LEM software

2.4.5 Life Safety Model, UK/Canada

The Life Safety Model is a detailed micro-modelling tool that can aid in assessing risk to people and evacuation times from a range of flood events including: fluvial floods, flash floods; dam breaks and breaches of flood defences. It uses a physics-based approach to simulate the physical interactions of people, vehicles and buildings in a major flood event.

For a given population at risk, LSM will:

- Estimate the potential loss of life due to an extreme flood event;
- Estimate evacuation times;
- Provide an estimate of the potential number of buildings that will collapse;
- Produce a spectrum of virtual representations of how a flood emergency could evolve;
- Support emergency analysis activities which aim to support the development of mitigation strategies that could reduce the potential loss of life.

LSM can also provide insight into the damage to structures, determine areas of greatest flood risk, and provide insight into the needs for timing and location of evacuation as the flood progresses.

Unlike other loss estimation techniques, LSM has been designed to look at specific areas, and utilise detailed local data. To date, the model has been tested on a few case studies to confirm the suitability and validity of the techniques. The model is currently being used in Humberside in England to assess evacuation times and risk to people. The LSM provides a more transparent and defensible set of predictions, which incorporate a wider range of variables influencing loss of life than traditional "black box" approaches. Figure 2.15 show an example output from the LSM showing the number of people at risk for different scenarios. Figure 2.16 shows a screen shot of an animation of an evacuation.

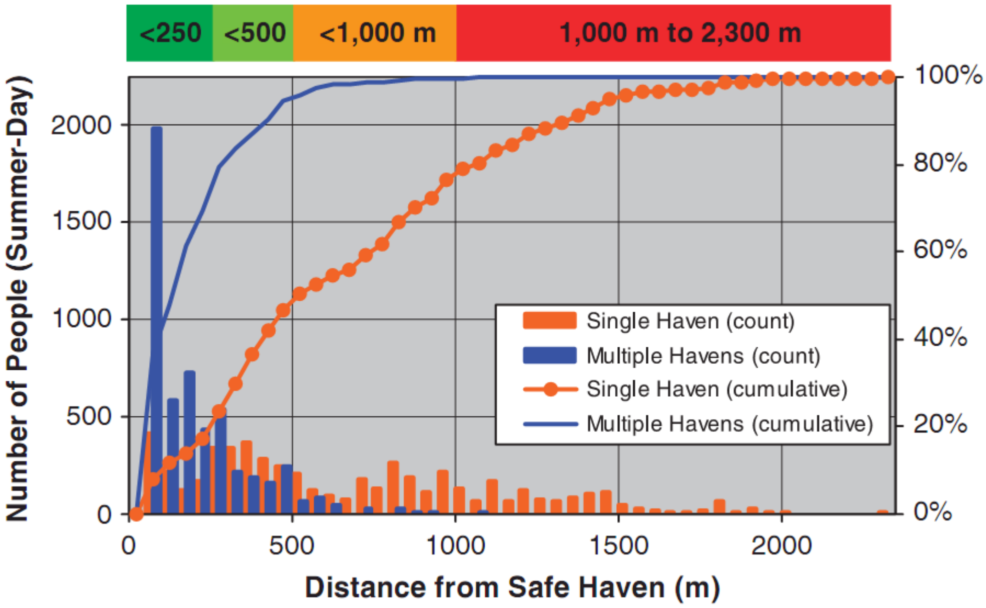


Figure 2.15 **Results from the Life Safety Model Evacuation showing the population at risk in a costal zone as a function of distance from safe haven(s) for summer daytime**

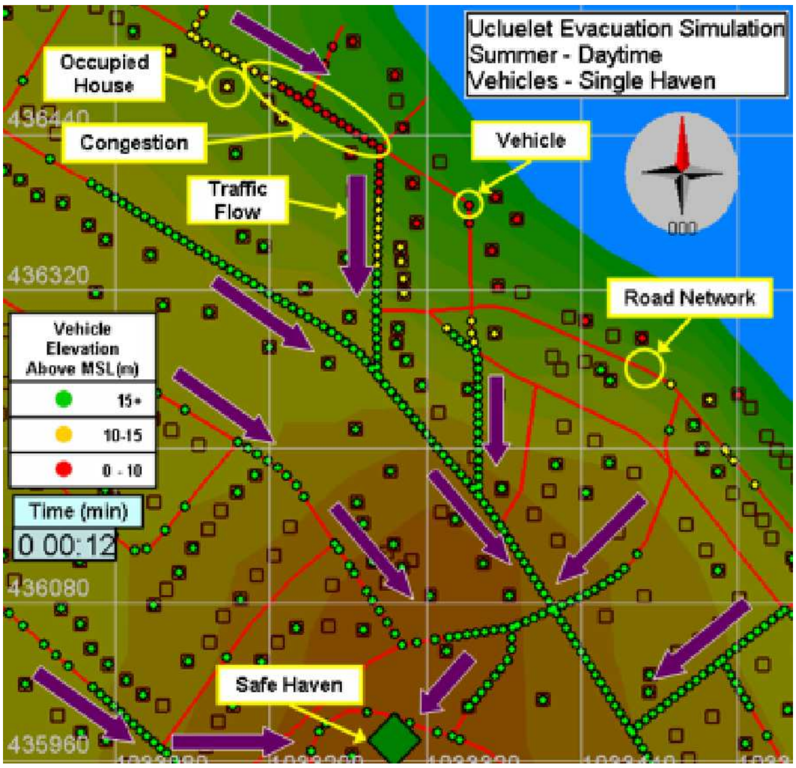


Figure 2.16 **Screenshot of summer daytime, single haven, vehicular evacuation simulation for people at risk of flooding in a coastal zone**

2.4.6 Flood Information and Warning system (FLIWAS), The Netherlands

FLIWAS is a web-based system and consists of different independently usable modules. FLIWAS is primarily intended for water management professionals and for decision makers on different levels. The water manager can access information that can be used to take appropriate practical actions during flood events. FLIWAS can be linked to an evacuation module. Information on current and predicted water levels or weak spots in embankments can be supplied. Decisions can then be taken about protecting flood defences.

In terms of emergency planning FLIWAS can be used to help decision makers assess how to respond to a flood event, and used to help formulate flood emergency plans, as well as being used in exercises. FLIWAS has cost some €10 million to develop. To a certain extent it acts as a repository for a whole range of information that could be useful to emergency planners including:

- A library of pre-calculated flood depth maps as shown in Figure 2.17;
- Provision of evacuation times using a separate module;
- Information relating to the places where the dike ring is weak or is likely to collapse;
- Provision of situation reports for emergency plans.

A diagrammatic overview of FLIWAS is shown in Figure 2.18.

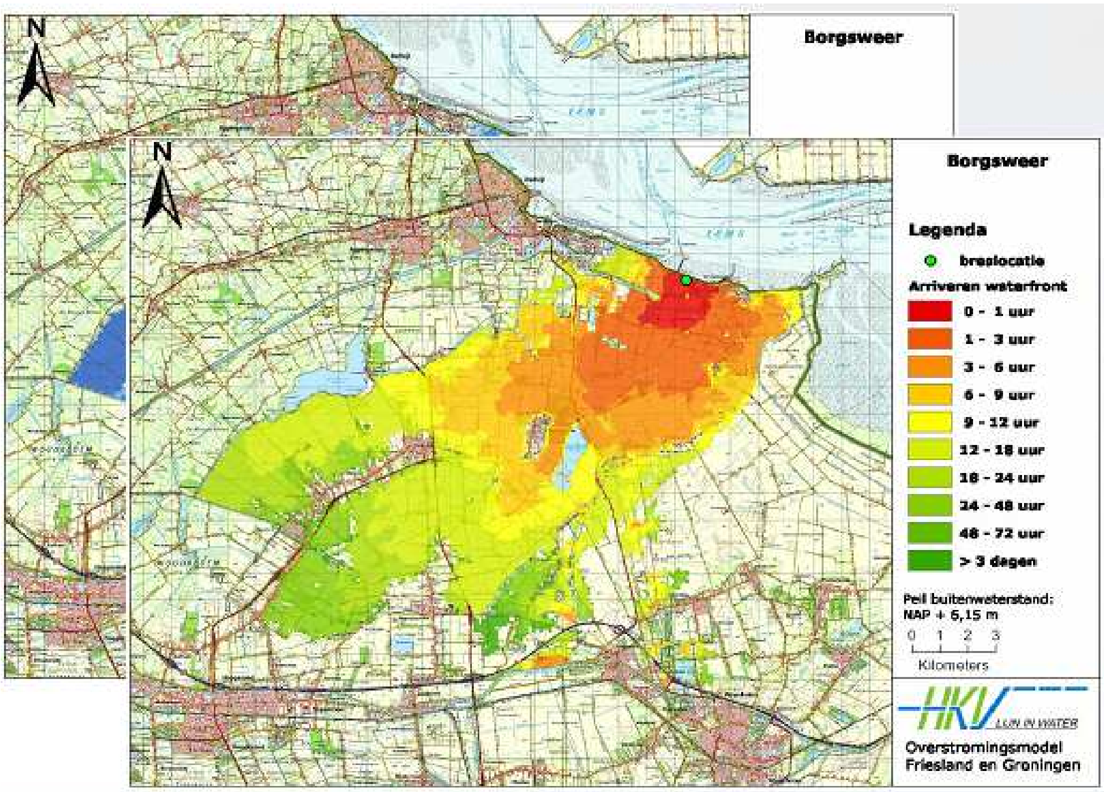


Figure 2.17 Example of pre-calculated flood maps used in FLIWAS

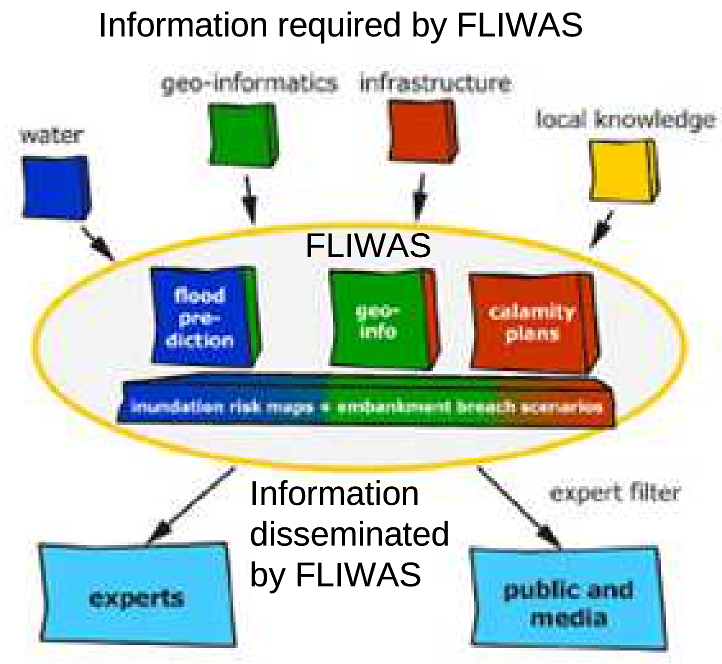


Figure 2.18 Diagrammatic overview of FLIWAS

2.4.7 *Stability of vehicles in floodwater, Australia/UK*

Keller and Mitsch (1993) carried out research on the stability of both cars and people in flood conditions to inform the design of urban streets as floodways for floods with a return period of greater than 1 in 5 years. The research took an entirely theoretical approach and considered the physics of vehicle and person stability in flood conditions. The analysis of vehicle stability involved calculations for three types of common cars. The vehicle stability calculations were based on the distribution of the buoyancy force between the two axles. The axle load for the front and rear axle was estimated from car manufacturer' specifications. A simple spreadsheet was set up using the research carried out by Keller and Mitsch. This could be used to inform the accessibility of roads during flood events. A typical example of stability curves for fours types of vehicles, related to the velocity and depth of the flood water is shown in Figure 2.19.

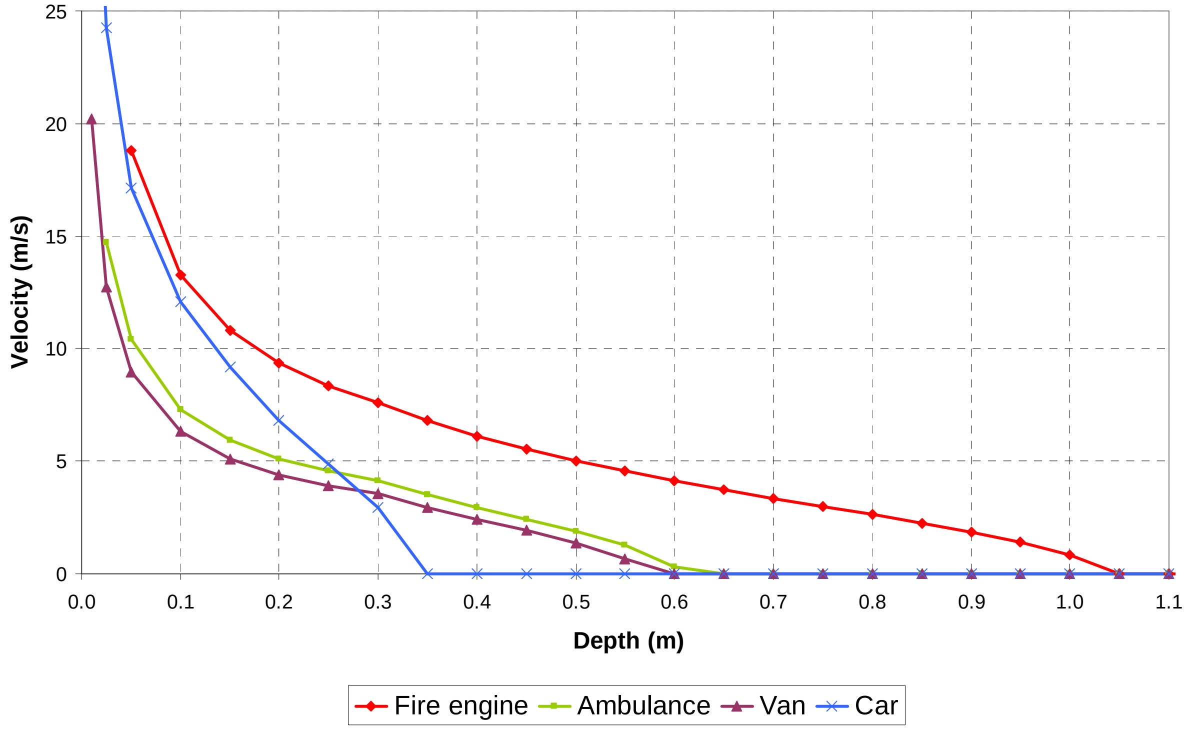


Figure 2.19 Stability of different vehicles in flood water as a product of the depth and velocity

2.4.8 Evacuation Calculator, The Netherlands

The Evacuation Calculator (EC) was developed in order to calculate how much time is required for evacuation and to determine the effect of traffic management during the evacuation process on the required evacuation time. The EC is used for the generation and distribution of trips, one might say the traffic load distribution to the traffic network. The traffic model has the function of managing the network and allocating the available transport capacity to the load generated by the EC.

A summary of the way in which the EC works is given below:

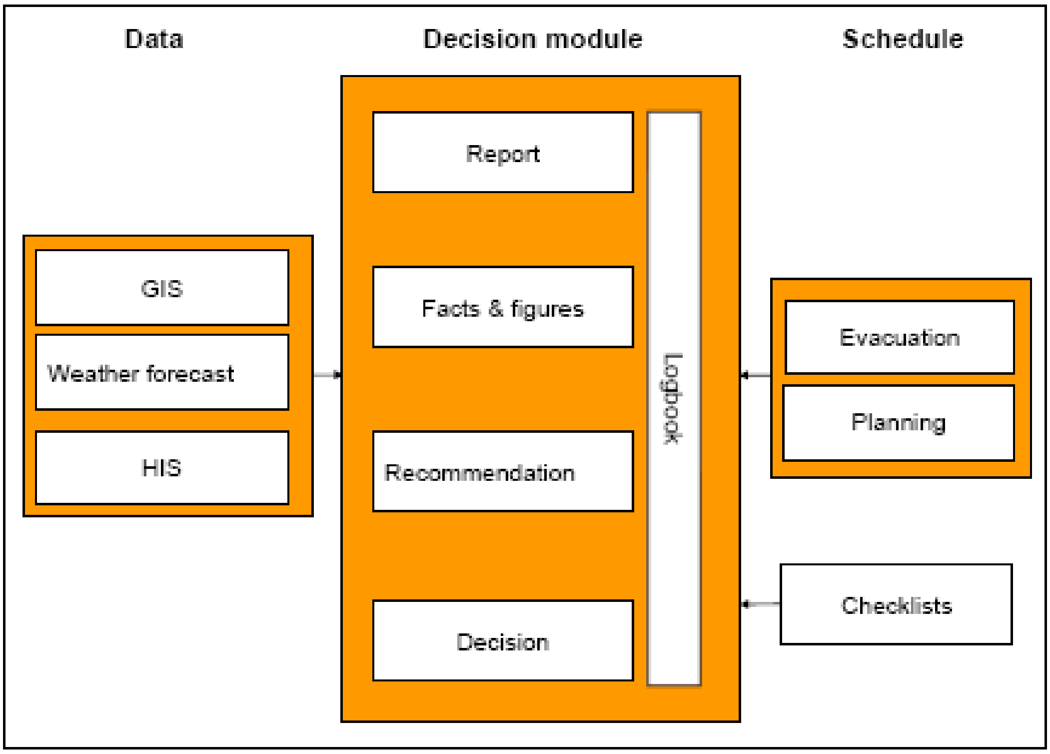
i. The EC first calculates the number of trips needed to evacuate each postal code area which is marked as a 'source zone'. The number of trips depends on the number of people and cattle present and the distribution of the people over different evacuation categories.
ii. The EC distributes the number of trips from all source zones over the different exits available. For this distribution there are four options:
   - Reference: The evacuees from each source area are equally distributed over each exit. Each exit thus receives the same number of people;
   - Nearest exit: People go to the exit nearest to them;
   - Traffic management: The vehicle distance will be minimised given a use of the exits proportional to the projected capacity;
   - Outflow areas: the user is free in assigning origin zones to a set of one of more exits. Within each combination of origins and destination(s) the traffic management method will be applied (minimising the vehicle distance given the use of the exits proportional to the projected capacity).

iii. The EC calculates the time needed for all people to organise themselves for departure and to drive from the source zone to the exit zone
iv. The EC determines the time needed at the exit

The EC calculates one situation assuming a best case regarding behaviour of people and traffic flow.

2.4.9 ESCAPE, The Netherlands

ESCAPE stands for European Solutions by Co-operation And Planning in Emergencies. As part of the ESCAPE project a Decision Support System (DSS) was developed. The Escape DSS consists of a module for the calculation of potential damage and casualties as a result of inundation, and a module that permits the calculation of the time required for the evacuation of a certain area as a function of the location and number of people to evacuate, the capacity of evacuation roads and the available exits of the area. To determine the evacuation, this system uses the different input data: demography; road inventory; weather conditions. Furthermore, for every area the number of inhabitants, their location, and the number of disabled and elderly people has to be known. Figure 2.20 shows the modular setup of Escape.



(Source: Lumbroso et al)
Figure 2.20 Modular setup of Escape

2.4.10 INDY, The Netherlands

INDY provides a method to assess mass evacuation times for floods using a dynamic model. It was produced by Netherlands Organisation for Applied Scientific Research Building and Construction (TNO) and Delft University of Technology. For the evacuation model the dynamic traffic assignment (DTA) model called INDY was used. The model allows the analysis of traffic scenarios on transportation networks. Its flexible modelling of the interactions between travel demand and infrastructure supply allow it to predict the traffic conditions of a road network over time, identify the locations where congestion occurs and estimate the corresponding delays. INDY is able to simulate traffic over the network in a realistic way such that the results serve as a good indication of the expected traffic outcome resulting from an evacuation. After the simulation is completed, the results can be visualised using the specialist software.

2.4.11 *Probability of building collapse, UK/USA/Others*

This is not a tool as such; however, there has been some limited research into the combinations of velocity and depth of floodwater that are required for the collapse of buildings during a flood. Some typical curves are shown in Figure 2.21. These could be used to define zones where probabilities of the collapse of buildings following a dam or flood defence failure can be mapped. An example of how this can be done is shown in Figure 2.22.

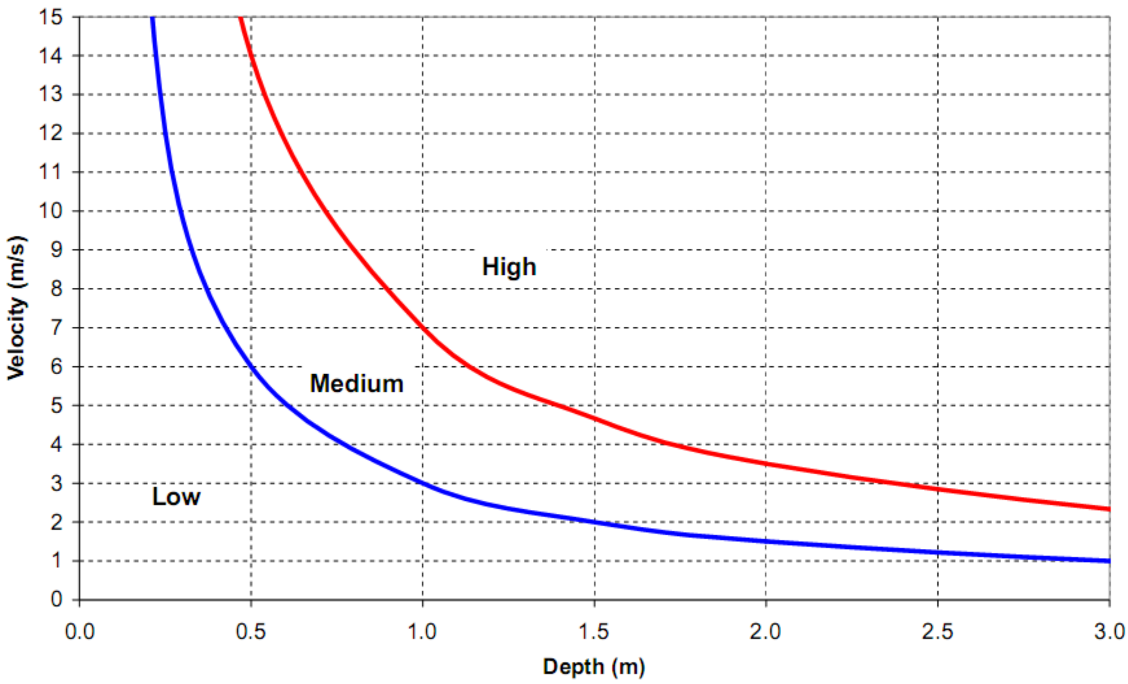


Figure 2.21 Graphs of floodwater velocity vs. depth that can be used to estimate the probability of building collapse

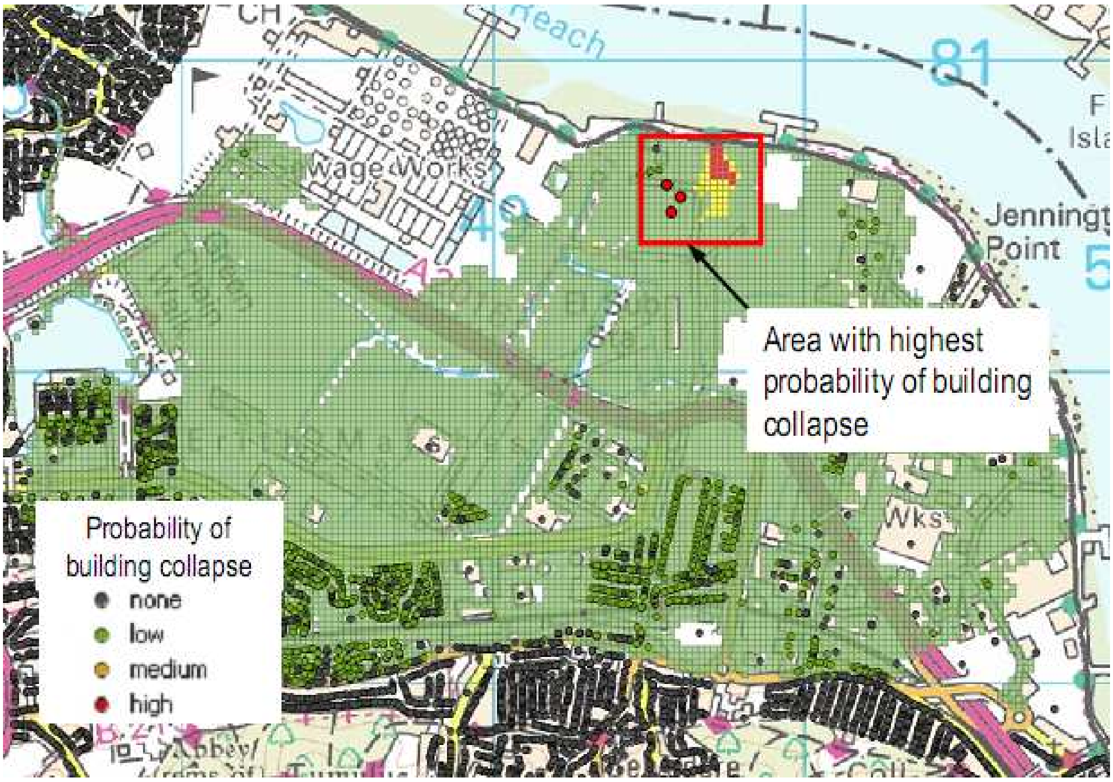
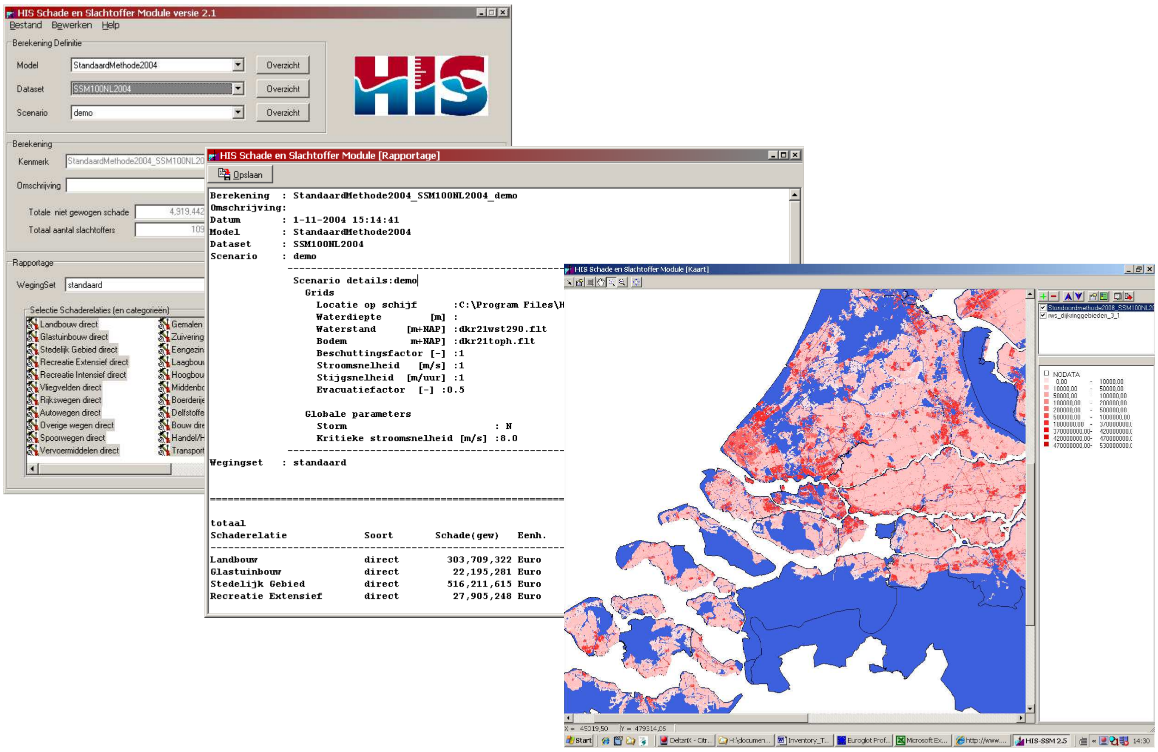


Figure 2.22 Probability of building collapse

2.4.12 *HIS SSM, damage and casualties module, The Netherlands*

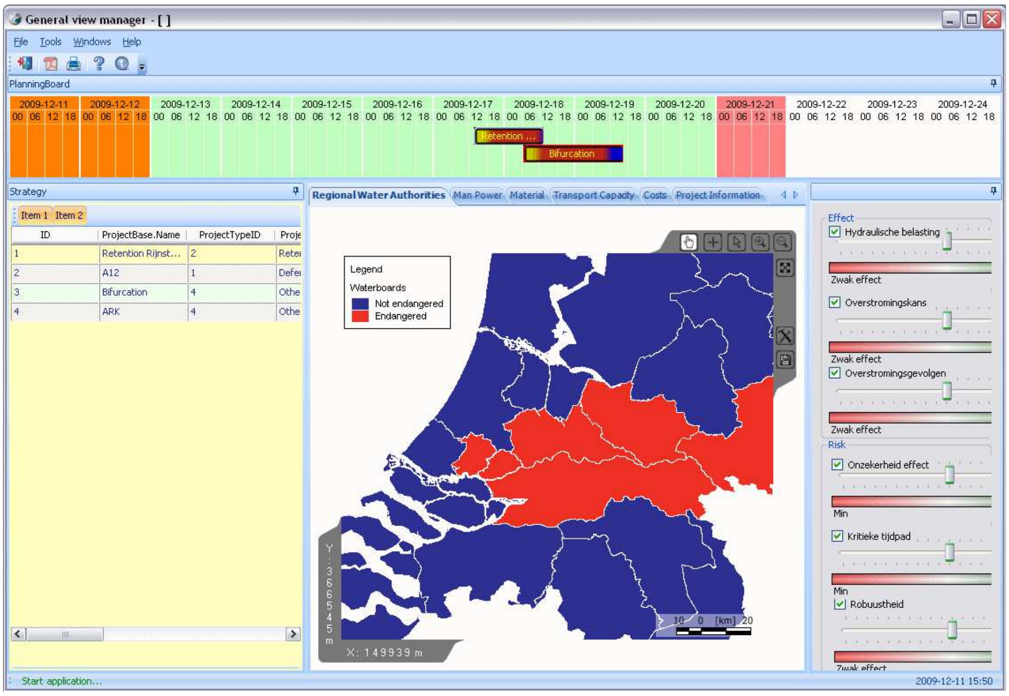
The tool was developed by the Dutch Ministry of Traffic, Public Works and Water Management to determine damages and casualties for different flooding scenarios. The tool provides a standardized method for the Netherlands to ensure that the calculation of damages and casualties are being performed in a uniform manner. The tool is part of the Flood Information System (HIS) but can be used stand-alone. The tool requires water depth maps as an input. Figure 2.23 shows the user interface, report and map results from the HIS SSM.



(Source: Groot Zwaaftink and Dijkman)
Figure 2.23 User interface, report and map results from the HIS SSM

2.4.13 Planning kit for flood event measures, The Netherlands

The planning kit was developed by Deltares, and provides insight into measures which can be taken to manage a flood event or to reduce the impact of flooding. The kit is an assembly of all possible measures and their effects. The effects have been pre-calculated to avoid extensive calculations to be made during an actual event. The kit includes measures which are thought to be applicable but are not adequate as a result of for example side-effects. The planning kit includes information on required resources and costs. It is currently at a prototype stage but may be used in the future by emergency planners. Figure 2.24 shows an example screen from the prototype planning kit for flood event measures.

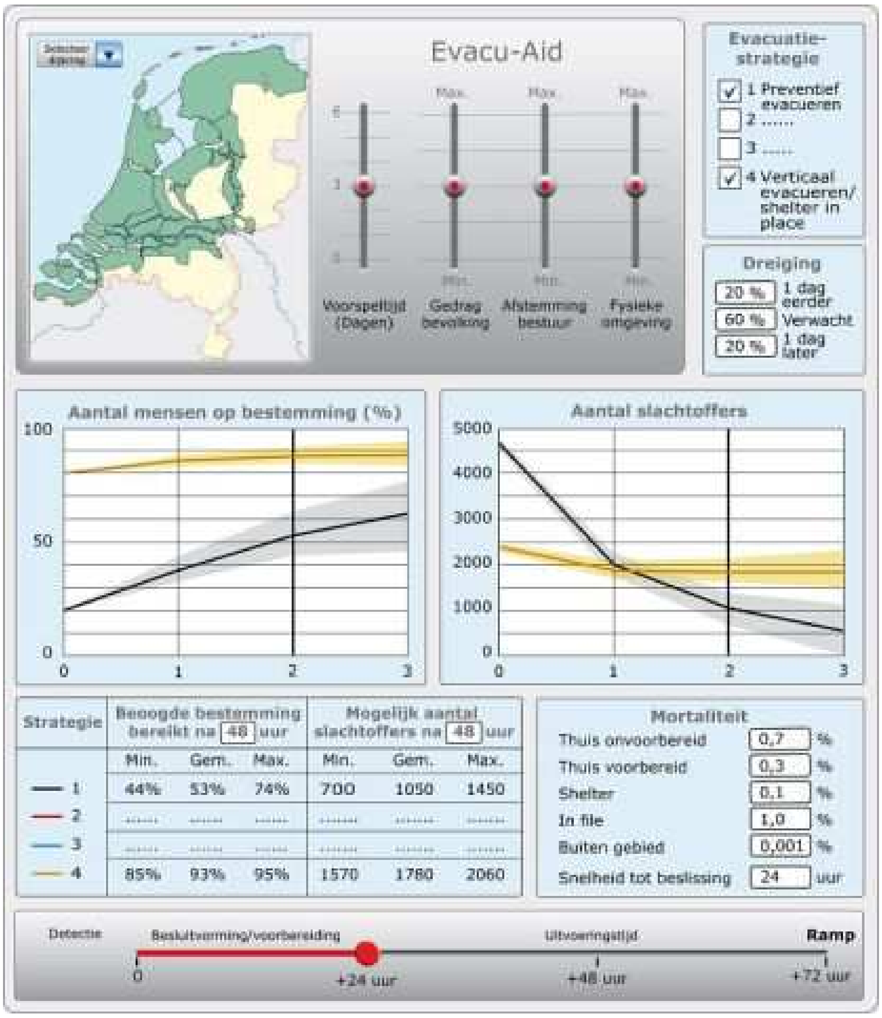


(Source: van Ruiten and Hendriks)

Figure 2.24 Example screen from the prototype planning kit for flood event measures

2.4.14 *EvacuAid*

EvacuAid was developed to evaluate different evacuation strategies. EvacuAid can be used during an event for decision support and for event planning to evaluate different evacuation strategies. EvacuAid consists of a database with simulation results from the National Evacuation Module. To gain insight in the outcome of an evacuation strategy, assumptions are made on the threat, the behaviour of people, decisions made by the government and the physical aspects and the interaction between these aspects. Several evacuation scenarios can be defined with different sets of assumptions. It is currently at a prototype stage. Figure 2.25 shows example Evacu-Aid screens.



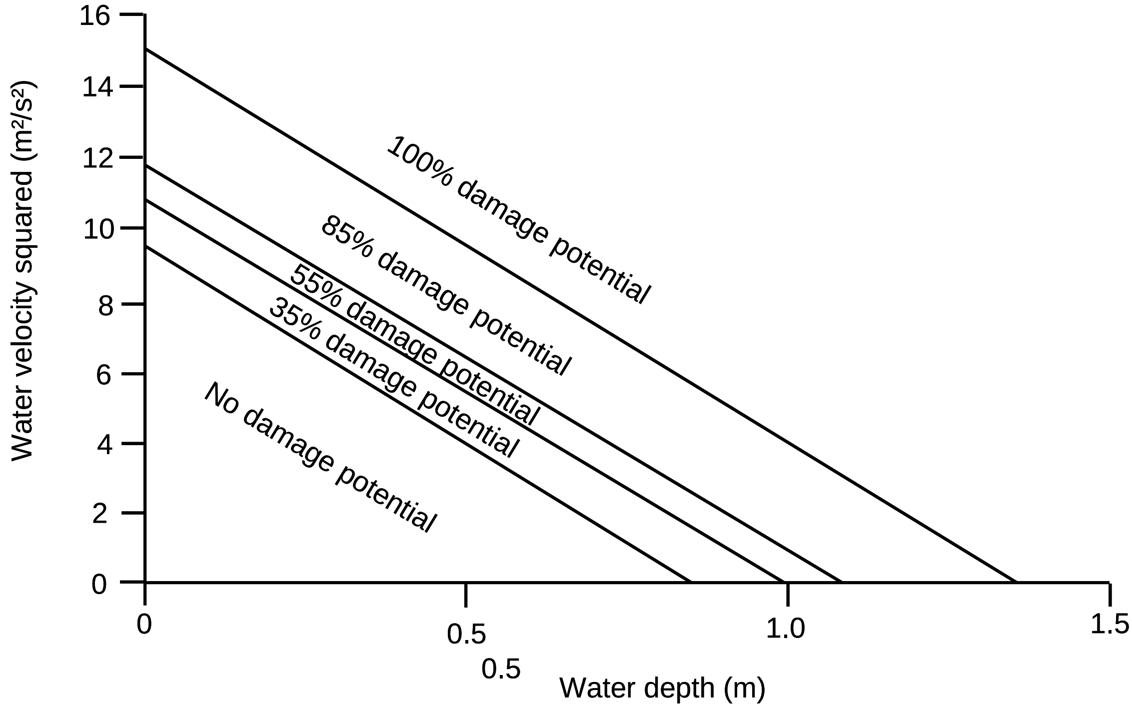
(Source: Kolen)

Figure 2.25 Example of EvacuAid screen

2.4.15 *NaTECH hazards*

Industrial accidents triggered by natural events (NaTech accidents) are a significant category of industrial accidents and important for emergency plans. Several specific elements that characterize NaTech events still need to be investigated. In particular, the damage mode of equipment and the specific final scenarios that may take place in NaTech accidents are key elements for the assessment of hazard and risk due to these events.

In the case of floods no simplified equipment damage models are available in the literature. There is only very limited data available to analyze in detail the damage caused by floods to industrial equipment. The information about past accidents recorded in industrial accident databases is usually not sufficiently detailed, in particular with respect to the description of the structural damage of equipment caused by the floods. There have been some limited tools available to assess NaTech hazards using simple damage functions such as those shown in Figure 2.26.



(Source: Bonvicini et al, 2009)

Figure 2.26 Example of simple damage function for use in assessing NaTech damage by flood water

3 Review of the results of the research undertaken with flood managers

3.1 Introduction

The research undertaken with flood managers in WP2 was to gain an idea of the level of awareness that flood managers had of the tools that have been developed and that could be potentially used to improve flood emergency plans. This chapter summarises the details of the research undertaken with stakeholders. Stakeholders were engaged through two main methods:

- Face-to-face discussions and meetings;
- An online survey in English, Dutch and French that was disseminated to flood managers within the three partner countries.

The objectives of the research undertaken with the stakeholders were to assess the awareness amongst flood managers of the tools that they currently use and also to attempt to ascertain the level of awareness of the tools that are available. The results of this research are summarised below. Details of the surveys and full results are given in Appendices A, B, C and D.

3.2 Introduction to the surveys

For each of the countries the flood managers were asked about the tools, methods and guidelines that they currently use or knew of that could be of assistance in formulating emergency plans for floods. The following choices were given in the survey:

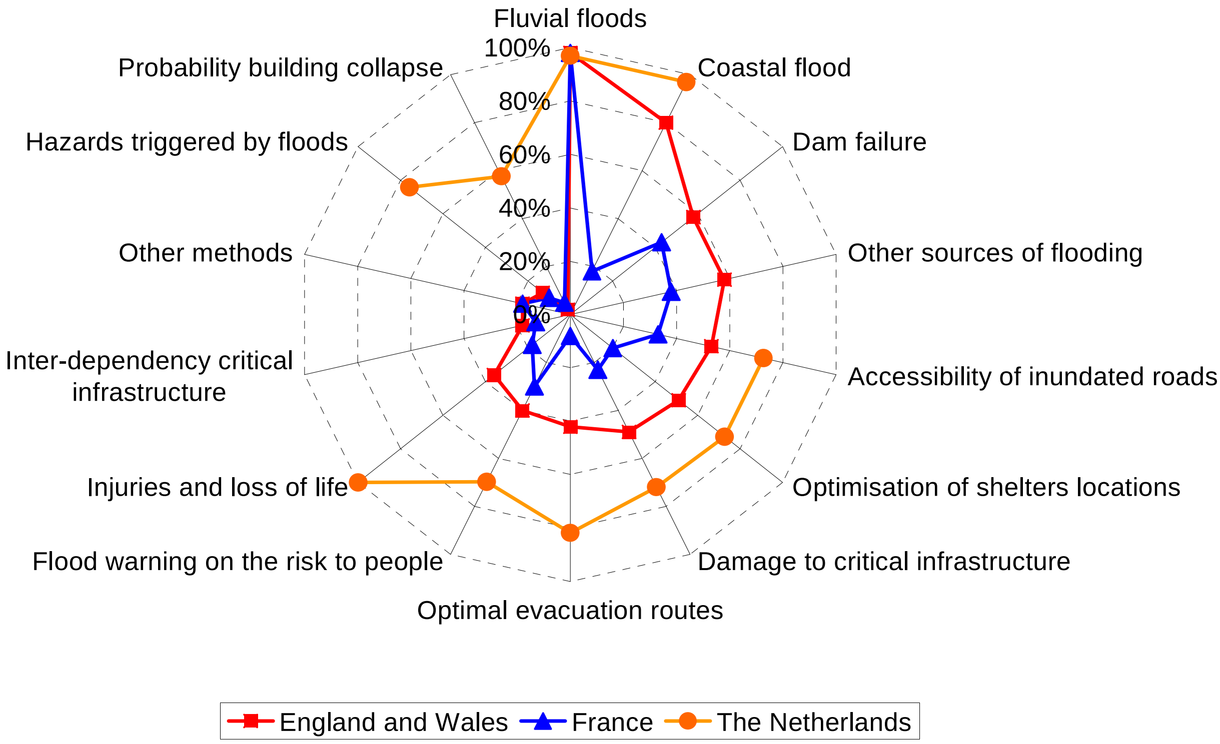
- Methods to assess the flood hazard from fluvial floods;
- Methods to assess the flood hazard from coastal floods;
- Methods to assess the flood hazard from dam failures;
- Methods to assess the flood hazard from other sources;
- Methods to assess potential injuries and loss of life during floods;
- Tools to assess the “accessibility” of inundated roads to emergency services and other vehicles;
- Methods to assess the optimal evacuation route(s) from inundated areas;
- Tools to assess the effects of improvements in the dissemination of flood warnings on the risk to people;
- Tools to assess the potential damage to critical infrastructure (e.g. gas, water and electricity supplies);
- Methods to assess the inter-dependency between critical infrastructure;
- Tools to optimise the location of shelters with respect to the flood hazard;
- Methods to assess other hazards triggered as the result of flooding;
- Methods to assess the probability of buildings collapsing during floods.

The research also investigated what tools are actually being used by flood managers to help them inform emergency plans, and also the reasons why tools were not being used. Finally flood managers were asked to provide comments on tools, methods or guidance that could usefully contribute to improving emergency plans for floods. The results of the surveys are summarised below.

In England and Wales there was 53 Environment Agency staff who responded to the survey of which 39 completed all the questions. In France 77 flood managers commenced the survey with 31 people completing all the questions. It is important to note that in the Netherlands the response rate to the survey was low. There were eight responses of which five people worked for a Dutch research institute who produce tools for flood risk management.

3.3 Awareness of tools available

As part of the survey flood managers in the three countries were asked which tools, methods and guidelines they used or knew of that were of use in formulating emergency plans for floods. The list of options that was provided in the survey is detailed in Section 3.2. Figure 3.1 shows the percentage of responders in the three countries who use or are aware of the different tools.



Note: Questions relating to dam failure; other sources of flooding; inter-dependency of critical infrastructure; and other methods were not included in the Dutch survey as they were not seen as relevant to the situation in the Netherlands
Netherlands results based on a sample of eight people five of whom work at a Dutch institute that carried out research into flood risk and flood emergency management

Figure 3.1 Percentage of responders who use or aware of a method that contribute to flood emergency plans

Figure 3.1 shows that the level of awareness of tools was highest in the Netherlands followed by England and Wales, and then France. However, the results need to be interpreted with care. The response rate in the Netherlands was low with only eight people answering all the questions and five of these people work for a Dutch institute that carries out research into flood risk and flood emergency management tools and hence where awareness levels of the methods available could be argued to be higher than in a flood management organisation. Generally, a higher awareness was seen in England and Wales compared to France across all of the flooding aspects raised.

The awareness of methods to assess fluvial flood hazards (>90%) was very high in all three countries and high in England and Wales and the Netherlands relating to methods to assess coastal hazards. It is interesting to note that in France the level of awareness of tools to assess coastal hazards was low, around 20%.

Floodplain mapping and hydraulic modelling are both “mature sciences” in the Europe with hundreds of millions of Euros worth of mapping studies and modelling exercises being undertaken in Europe in the past decade. As a consequence it is understandable that most of the responders are familiar with the flood mapping outputs, tools and models. The level of awareness of the responders regarding tools that would cover the following was low:

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

When asked what tools they actually use very few responders from the three countries explicitly named tools that can carry out the above, even though they mentioned that they used them to inform their emergency management plans.

3.4 Obstacles to the use of tools

As part of the survey the responders were asked about the current usage of certain tools to inform flood emergency plans. The stakeholders were asked if they currently used the tools and if not to classify the reason into one of the following categories:

- Not relevant to emergency plans for floods;
- Unaware of the method;
- Cost
- User friendliness issues;
- Availability of data;
- Other reasons.

The responses to these questions are discussed below.

3.4.1 Obstacles to the use of tools to assess flood hazard

Figure 3.2 shows the responses for tools to assess the following sources of flood hazard:

- Rivers (fluvial);

- Coastal;
- Dams;
- Other sources.

The use of tools to assess fluvial and coastal flood hazards in England and Wales and the Netherlands was high, although some responders did state that methods to assess coastal flood hazards were not relevant to their plans; however, these were responders who lived in landlocked" areas unaffected by coastal flooding. The level of awareness of tools to assess the coastal flood hazard was low in France (only approximately 45% of responders). It is interesting to note that the level of awareness of the tools is higher than the percentage of responders (around 20%) in France who stated that these tools were actually used to inform emergency plans. With respect to assessing flood hazard from dams the major obstacle for these methods not being employed more frequently was "availability of data". Some 25% of responders in England and Wales and France indicated that this was an issue. Regarding assessing flood hazards from other sources (e.g. pluvial flooding) in France almost 20% of responders were unaware of methods to assess this hazard.

3.4.2 Obstacles to the use of tools to assess flood risk to receptors

Figures 3.3 and 3.4 show the survey responses for tools to assess the following that are mainly related to receptors (i.e. people, buildings or infrastructure) located in the floodplain:

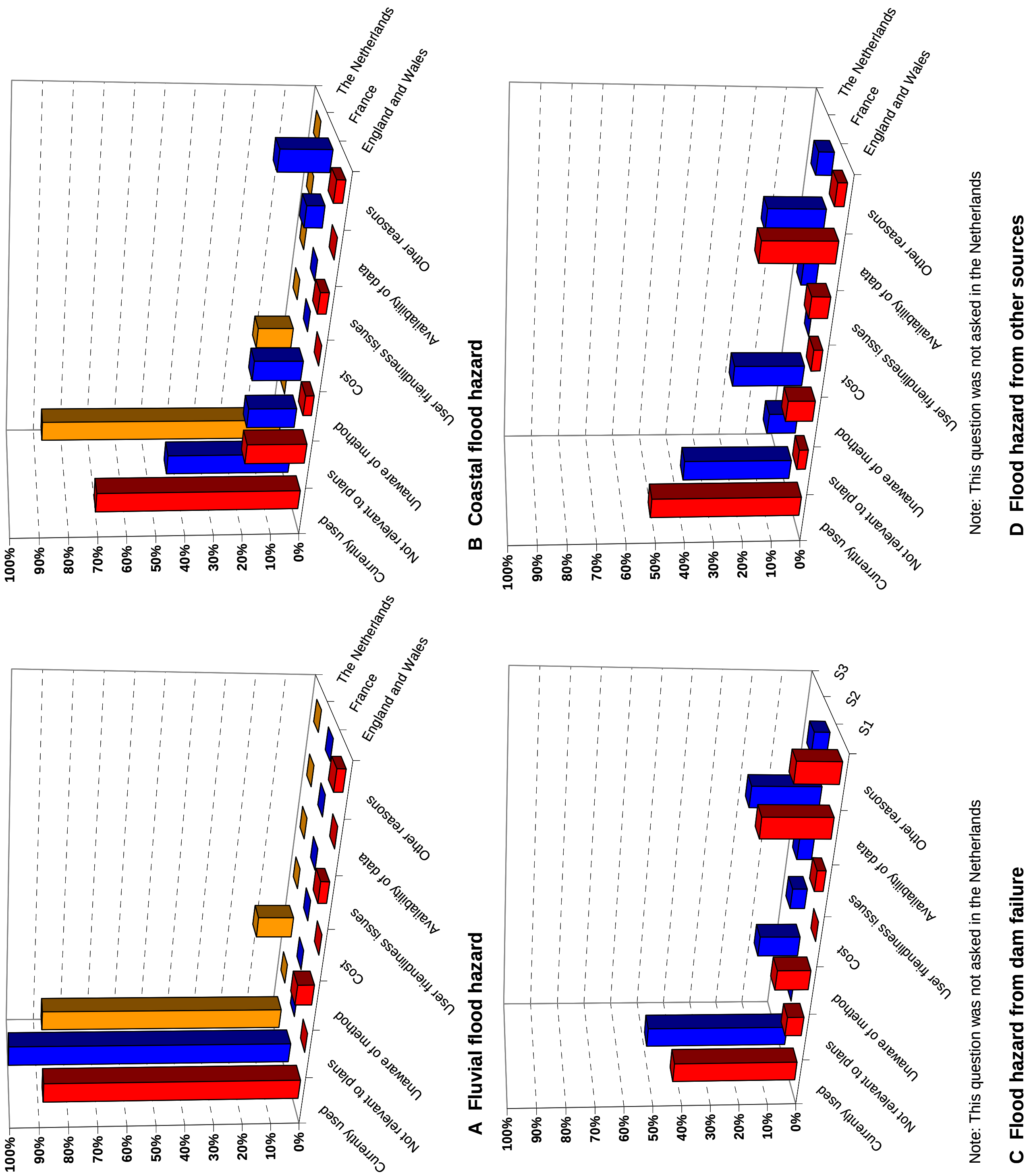
- Potential injuries and loss of life
- Accessibility of inundated roads to vehicles
- Optimal evacuation route(s) from inundated areas
- Effects of improvements in the dissemination of flood warnings on the risk to people
- Potential damage to critical infrastructure
- Optimising the locations of shelters with respect to floods
- Assessment of other hazards triggered by flooding
- Probability of buildings collapsing during floods

Figures 3.3 and 3.4 show that the main reason for the lack of use of tools for the type of tools listed above was "unawareness of the method". A typical reply that indicates that there is a lack of awareness of exactly what tools are available was as follows.

"*I'm not sure what you meant by any of this really. Where we have ways and means locally of determining the information you refer to I have considered that to be a tool we use but the wording of this survey implies there are specific nationally developed tools and models out there to deliver the information. If this is the case most of my answers would be that I am not aware of the tool!*"

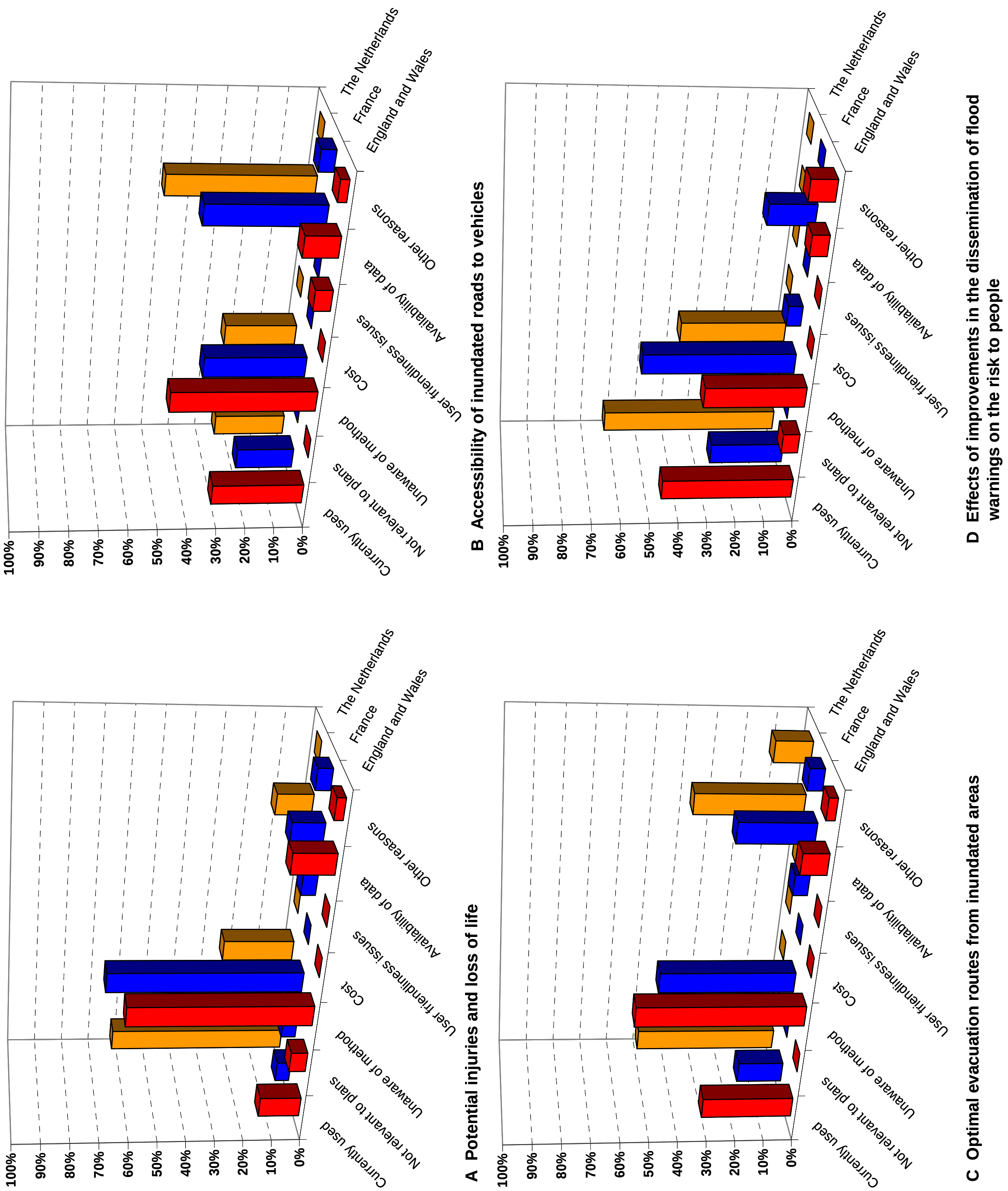
User friendliness was not seen by the responders to be an obstacle to the use of tools but this may be linked to that fact that there was a high level of unawareness concerning these types of tools meaning that responders were unable to comment knowledgably on these issues. It is interesting to note that cost was not seen as a major constraint for the implementation of the methods. Very few users (<3%) indicated that the methods listed in the survey were not relevant to formulation of emergency plans for floods.

Very few of the responders to the survey (<3%) who are involved in providing information to assist with the formulation of emergency plans explicitly mentioned any methods or tools that provide information on the above subjects. For example discussions with one responder indicated that in the case of accessibility of roads to emergency vehicles often "rule of thumb" methods were used (i.e. emergency services would be told that roads were inaccessible if there was 200 mm or more of water covering the road) rather than a more “scientifically” based method.



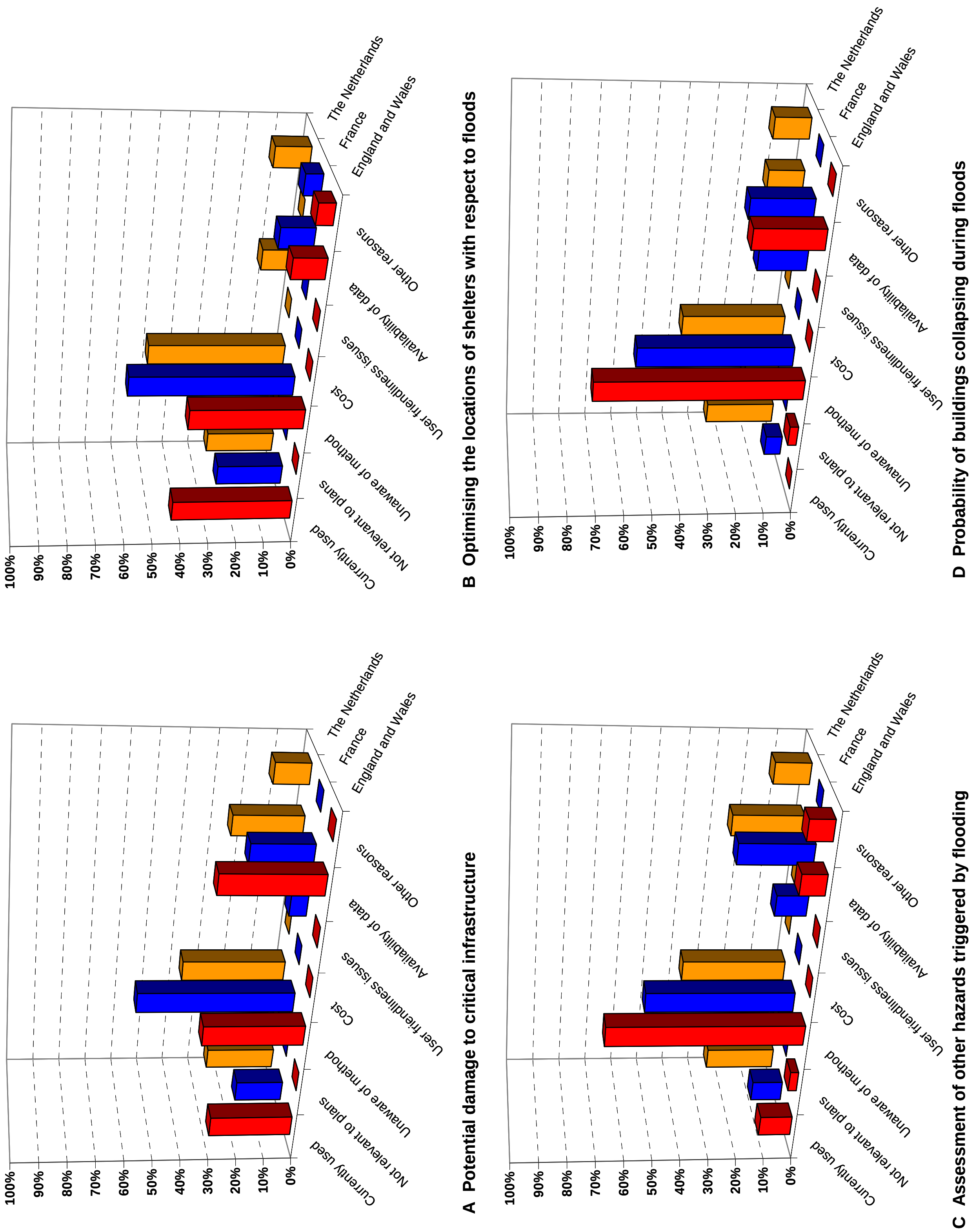
Note: Netherlands results based on a sample of eight people five of whom work at a Dutch research institute

Figure 3.2 Comparison of obstacles to using tools to assess flood hazard from different sources



Note: Netherlands results based on a sample of eight people five of whom work at a Dutch research institute

Figure 3.3 Comparison of obstacles to using tools to assess flood risk to receptors – Part 1



Note: Netherlands results based on a sample of eight people five of whom work at a Dutch research institute

Figure 3.4 Comparison of obstacles to using tools to assess flood risk to receptors – Part 2

4 Conclusions

From the research carried out many flood managers are often not aware of the tools that are available to assist them in providing information to emergency plans for floods. Based on the online survey of flood managers in the three countries, the two main obstacles to tools not being used appear to be:

1. Lack of awareness of the methods that are available
2. Availability of data

In formulating emergency plans for floods it would appear that "expert judgement" is often used rather than specific tools. Many responders to the survey mentioned that they used a combination of information rather than specific methods or tools. For example in the survey in England and Wales around half to a third of the responders stated that they were aware of or used the following methods to inform Multi-Agency Flood Plans (MAFPs):

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

However, none of the 44 responders who are involved in providing information to assist with the formulation of MAFPs explicitly mentioned any methods or tools that provide such information.

In France the awareness level of the tools and methods available would appear to be lower than that in England and Wales and the Netherlands. The lack of awareness in general may be as a result of a need to improve the dissemination of the tools and the relevant research. The lack of awareness of tools to assess the consequences of flooding or to assess potential damage has already been pointed out in many articles and reports in France (Hubert & Ledoux, 1999).

In all three countries there would appear to be a requirement for some form of guidance on what tools are available, what data they require and how they can be implemented to give information that can be used to improve emergency plans for floods.

5 References

ALEXANDER, D (2002) Principles of emergency planning and management, Terra Publishing, Harpenden and Oxford University Press, New York

ALEXANDER, D (2003) Towards the development of a standard in emergency management training and education, Disaster Prevention and Management Vol. 12 No. 2 pp 113-123

ALEXANDER, D (2005) Towards the development of a standard in emergency planning Journal of Disaster Prevention and Management Vol.14 No. 2, 2005

BONVICINI, S, SPADONI, G AND COZZANI, V (2009) Development of a framework for the risk assessment of Na-Tech accidental events Reliability Engineering and System Safety 94 (2009) 1442–1450

DRABEK, T. E. AND HOETMER, G.J. (1991) Emergency management: Principles and practice for local government, International City Management Association, Washington DC, USA

DEFRA (2008) A National Flood Emergency Framework Proposals for consultation, December 2008

DIRECTION DE LA DEFENSE ET FE LA SECURITIE CIVILES (2004) Plan communal de Sauvegarde – Guide Practique D'Elaboration

DIRECTION DE LA DEFENSE ET FE LA SECURITIE CIVILES (2006) Guide ORSEC Départemental – Méthode générale – Tome G.1 – Décembre 2006

DEFRA/ENVIRONMENT AGENCY (2006) Flood and Coastal Defence R&D Programme Flood Risks to People Phase 2 FD2321/TR2 Guidance Document

ENVIRONMENT AGENCY/DEFRA (2008) Developing a Multi-Agency Flood Plan (MAFP) Guidance for Local Resilience Forums and Emergency Planners February 2008 version 4.4

ENVIRONMENT AGENCY/DEFRA/CIVIL CONTINGENCIES SECRETARIAT (2009) Checklist for Multi-Agency Flood Plans (MAFP) 15 December 2009

ERLICH M. (2007) OSIRIS – An example of citizen-oriented technology development in the area of dissemination of information on flood risk management, in Begum S. *Flood Risk Management in Europe*, Springer p. 107-129.

HKV CONSULTANTS AND DELTARES (2009) LEM 2.0 factsheet 1; Wat bereik je met LEM

HUBERT, T (Undated) Les Plans de Prévention des Risques naturels PPR

HULPVERLENINGSREGIO HAAGLANDEN (2005) Regionaal model rampenplan in de zin de van de Wet rampen en zware ongevallen

INSPECTION FOR PUBLIC SAFETY AND ORDER, MINISTRY OF INLAND AFFAIRS, THE NETHERLANDS (2009) Toetsingskader RADAR

GROOT ZWAAFTINK, M.E. AND DIJKMAN, M. (2007) HIS-Schade en Slachtoffers Module versie 2.4 Gebruikershandleiding, Ministry of traffic, public works and water management

KELLER, R.J AND MITSCH, B (1992) Stability of cars and children in flooded streets, International symposium on urban storm water Sydney 4-7 February 1992

KELLER, R.J AND MITSCH, B (1993) Safety aspects of design roads as floodways, Research report No. 69, Urban Water Research Association of Australia, International symposium on urban storm water Sydney 4-7 February 1992

KOLEN B., (2009) Samenvatting eindrapport EvacuAid, HKV Consultants

LUMBROSO D., GAUME E., LOGTMEIJER C., MENS M., VAT M. VAN DER (2008) Evacuation and traffic management, FloodSite Report Number T17-07-02

MINISTRY OF INLAND AFFAIRS, THE NETHERLANDS (2003) Gebruiksaanwijzing LOP tabellenboek en LOP Indicator, LMR en LOP, versie 2.2

MINISTRY OF INLAND AFFAIRS, THE NETHERLANDS (2004) Besluit kwaliteitscriteria planvorming rampenbestrijding, Staatsblad van het Koninkrijk der Nederlanden

RUITEN, K. VAN AND HENDRIKS A. (2009) Ontwikkeling Blokkendoos LCOMaatregelen Meerjarig plan van aanpak, Deltares

SAVE AND AVD (Ingenieurs Adviesbureau SAVE & Adviesbureau Van Dijke) Leidraad Maatramp versie 1.3

Acknowledgments

The FIM FRAME team members would like to thank all the stakeholders across England and Wales, France and the Netherlands who contributed to the work package by filling in the survey or by making time for the face-to-face consultation.

Appendix A Details of the online surveys

A1 England and Wales survey

Exit Survey »

12%

Hello

This brief survey has been developed by the Environment Agency in England and Wales and is *aimed at Environment Agency staff who produce information (e.g. flood hazard or risk maps, flood warnings etc) that may assist in the formulation of Multi-Agency Flood Plans.*

It has been put together to inform a research project called Flood Incident Management a FRAMEwork for improvement (FIM FRAME) www.fimframe.net. The project is part of the ERA-NET CRUE research programme (www.crue-eranet.net) that is partly funded by Defra/The Environment Agency. The CRUE network has been set up to consolidate existing European flood research programmes, promote best practice and identify gaps and opportunities for collaboration on future programme content. Its 16 partners, of which the Environment Agency is one, come from most European countries that have been particularly badly affected by flooding.

The project is being led by HR Wallingford (England & Wales) in partnership with Deltares (The Netherlands), Gestion des Sociétés, des Territoires et des Risques (GESTER), Université of Montpellier III (France) and the Laboratoire Central des Ponts et Chausées (France).

The objectives of the project are:

(i) To assess the effectiveness and robustness of current flood event management plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved
(ii) To evaluate the current tools that are used for flood event management planning and the ability of these tools to support the management of future flood emergencies
(iii) To establish how currently available tools can be used to improve emergency management plans for floods and whether there are any gaps in the available tools
(iv) To provide a framework by which flood incident management can be improved that will be tested in a case studies in France, The Netherlands and the UK

opportunities for collaboration on future programme content. Its 16 partners, of which the Environment Agency is one, come from most European countries that have been particularly badly affected by flooding.

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(iii) To establish how currently available tools can be used to improve emergency management plans for floods and whether there are any gaps in the available tools
(iv) To provide a framework by which flood incident management can be improved that will be tested in a case studies in France, The Netherlands and the UK

The main objectives of the survey are:

(i) To understand what tools, method, software and guidelines are currently used by the Environment Agency that could be of assistance to emergency planners in formulating Multi Agency Flood Plans
(ii) To understand what tools (e.g. methods, guidelines, checklists, software etc) if any, could be developed to assist with the development of Multi Agency Flood Plans

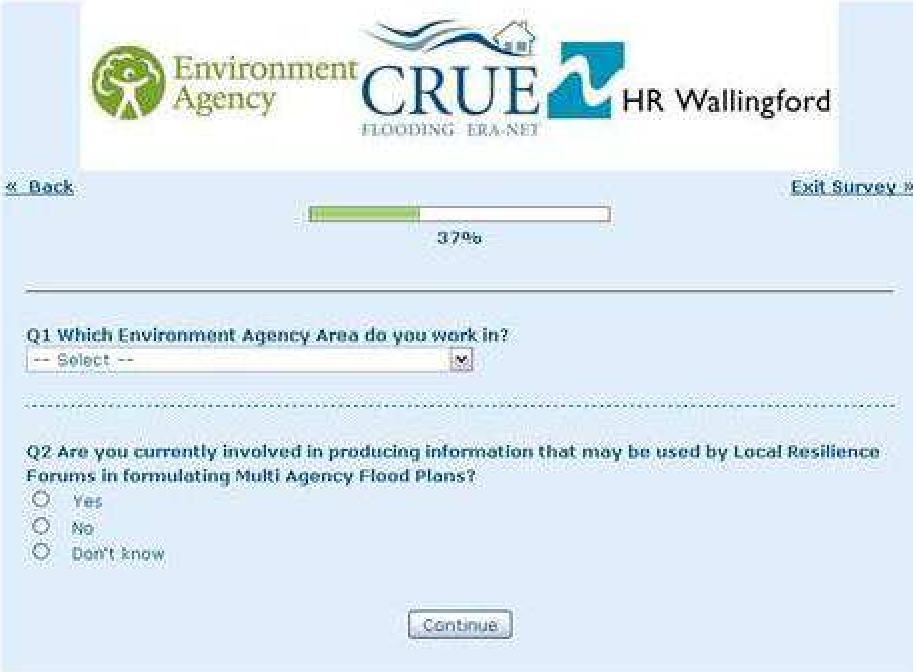
Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact Darren Lumbroso by email at d.lumbroso@hrwallingford.co.uk.

It should take no more than 10 minutes to complete the questionnaire.

Thank you very much for your time and support. Please start with the survey now by clicking on the Continue button below.

Continue


Environment Agency
CRUE
FLOODING ERA-NET
HR Wallingford
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Exit Survey »
37%
Q1 Which Environment Agency Area do you work in?
-- Select --
Q2 Are you currently involved in producing information that may be used by Local Resilience Forums in formulating Multi Agency Flood Plans?
Yes
No
Don't know
Continue

« Back

Exit Survey »

50%

Q3 What tools, methods and guidelines do you currently use, or know of, the outputs of which could be of assistance to Local Resilience Forums in formulating Multi Agency Flood Plans? Please tick all the boxes that apply.

- ☐ Methods to assess the flood hazard from fluvial floods
- ☐ Methods to assess the flood hazard from coastal floods
- ☐ Methods to assess the flood hazard from dam failures
- ☐ Methods to assess the flood hazard from other sources
- ☐ Methods and tools to assess potential injuries and loss of life during floods
- ☐ Tools to assess the "accessibility" of inundated roads to emergency services and other vehicles
- ☐ Methods to assess the optimal evacuation route(s) from inundated areas
- ☐ Tools to assess the effects of improvements in the dissemination of flood warnings on the risk to people
- ☐ Tools to assess the potential damage to critical infrastructure (e.g. gas, water, electricity supplies, police stations, hospitals etc) by floodwater
- ☐ Methods to assess the inter-dependency between critical infrastructure
- ☐ Tools to optimise the locations of shelters or reception areas with respect to the flood hazard
- ☐ Methods and tools to assess other hazards triggered as the result of flooding (e.g. additional hazards that could result from flooding of an industrial facility)
- ☐ Methods to assess the probability of buildings collapsing during floods
- ☐ Other tools used please list in the box below

Continue

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Exit Survey »

62%

Q4 Please list the names of the tools, methods or guidance that you currently use that are of assistance to Local Resilience Forums in producing Multi Agency Flood Plans?

Continue

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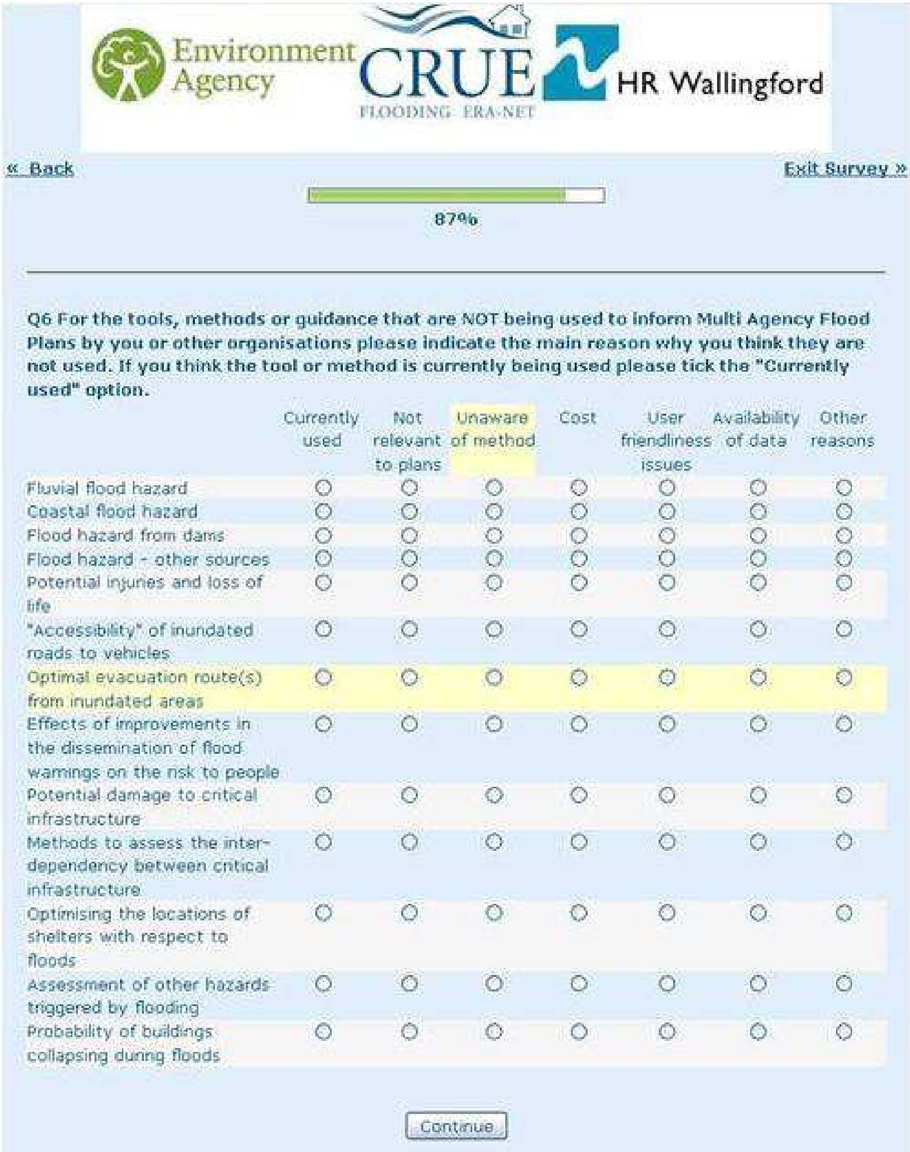
Exit Survey »

75%

Q5 Are there any other tools, methods or guidance that you would like to see developed that could be used by Local Resilience Forums to develop Multi Agency Flood Plans?

- No
- Yes - Please provide a brief description in the box below

Continue



Environment Agency CRUE FLOODING ERA-NET HR Wallingford

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87%

Q6 For the tools, methods or guidance that are NOT being used to inform Multi Agency Flood Plans by you or other organisations please indicate the main reason why you think they are not used. If you think the tool or method is currently being used please tick the "Currently used" option.

	Currently used	Not relevant to plans	Unaware of method	Cost	User friendliness issues	Availability of data	Other reasons
Fluvial flood hazard							
Coastal flood hazard							
Flood hazard from dams							
Flood hazard - other sources							
Potential injuries and loss of life							
"Accessibility" of inundated roads to vehicles							
Optimal evacuation route(s) from inundated areas							
Effects of improvements in the dissemination of flood warnings on the risk to people							
Potential damage to critical infrastructure							
Methods to assess the inter-dependency between critical infrastructure							
Optimising the locations of shelters with respect to floods							
Assessment of other hazards triggered by flooding							
Probability of buildings collapsing during floods							

Continue

« Back

Exit Survey »

100%

Q7 If you have any further comments that you wish to make about tools, methods or guidance that you believe could contribute to improving Multi Agency Flood Plans please add them to the box below.

Continue

The final project reports will be available from the project web site www.fimframe.net. If you would like any further information please contact the project coordinator Darren Lumbroso by email at d.lumbroso@hrwallingford.co.uk.

Thank you for completing this survey

A2 French survey

Exit Survey »

11%

Bonjour,

Ce questionnaire a été réalisé afin de renseigner un projet de recherche européen appelé «*Flood Incident Management, a FRAMEwork for improvement (FIM FRAME)*» www.fimframe.net. Ce projet fait partie du programme de recherche ERA-NET CRUE (www.crue-eranet.net), en collaboration avec le MEEDDM et des partenaires étrangers (Angleterre et Pays-Bas)

Le réseau CRUE a été mis en place pour renforcer les différents programmes de recherche européens sur les inondations, promouvoir les meilleures pratiques et identifier les lacunes et atouts dans la gestion du risque inondation. Ses 16 partenaires, dont le Ministère de l'Ecologie et du Développement Durable, viennent des pays européens qui ont été particulièrement touchés par le risque inondation.

Le projet est piloté par le laboratoire *HR Wallingford* (Angleterre et Pays de Galles), en partenariat avec *Deltares* (Pays-Bas), le laboratoire Gester (*Gestion des Sociétés, des Territoires et des Risques*) de Université de Montpellier III (France) et le Laboratoire Central des Ponts et Chaussées (France).

Objectifs de la recherche:

- Les objectifs du projet sont:

1. Evaluer l'efficience et la robustesse des plans de gestion du risque inondation actuels en Angleterre, aux Pays-Bas et en France, et évaluer les méthodes qui pourraient permettre d'améliorer ces plans.
2. Evaluer les outils actuels utilisés en matière de planification de la gestion de crise inondation et la capacité de ces outils à perfectionner la gestion des futures crises liées aux inondations.
3. Envisager la façon dont les outils actuellement disponibles peuvent être utilisés pour améliorer les plans de gestion de crise « inondations » et identifier les éventuels manques au niveau de ces outils.
4. Fournir un cadre d'étude pour l'amélioration de la gestion du risque inondation à travers des études de cas en France, au Pays-Bas et en Angleterre.

- Les principaux objectifs du questionnaire sont:

1. Comprendre quelles sont les informations qui peuvent aider les gestionnaires de crise lors de la réalisation de « plans de gestion de crise inondations ».
2. Connaitre les outils (méthodes, guide méthodologique, directive, logiciels d'aide à la décision etc) qui pourraient être développés afin d'aider à l'amélioration et à la diffusion des «plans de gestion de crise inondations».
Il est très important pour nous de connaître vos opinions.

Votre participation à cette étude est libre. Vous pouvez vous retirer de l'enquête à n'importe quel moment. Vos réponses au questionnaire seront strictement confidentielles et seuls les résultats généraux figureront dans le rapport. Vos informations seront codées et resteront confidentielles. Si vous aviez des questions concernant le questionnaire ou la procédure, veuillez contacter Freddy Vinet par e-mail à freddy.vinet@univ-montp3.fr ou le coordonnateur Darren Lumbroso (d.lumbrosos@hrwallingford.co.uk).

La réponse au questionnaire ne devrait pas prendre plus de dix minutes.

Nous vous remercions pour l'intérêt et le temps que vous avez porté à cette étude. Merci de commencer le questionnaire en cliquant sur le bouton suivant «continue».

Continue

« Back Exit Survey »

44%

Q1 Dans quelle DREAL/DDT travaillez-vous?
-- Select --

Q2 Dans quel service travaillez-vous?

Q3 Êtes-vous actuellement impliqué dans la production d'informations susceptibles d'être utilisés dans l'élaboration de plans de gestion de crise inondation (PCS, ORSEC, PPI)?

- Oui
- Non
- Ne sait pas

Continue

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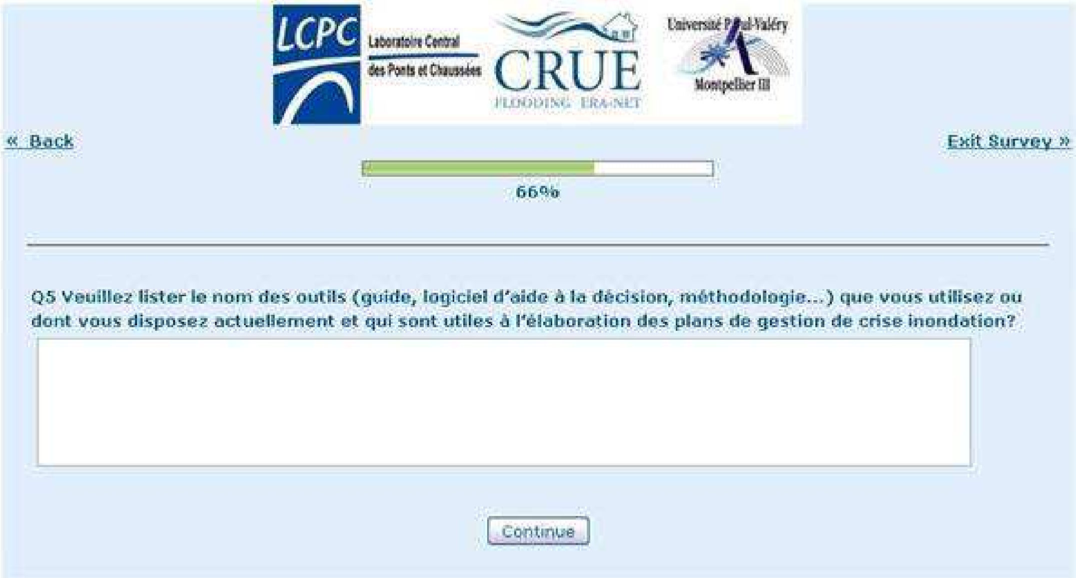
55%

Q4 Quels sont les outils et méthodes que vous utilisez habituellement, ou dont vous connaissez l'existence, et dont les résultats pourraient aider à la réalisation de Plans de gestion de crise inondation? Veuillez cocher toutes les cases qui répondent à la question

- ☐ Méthodes pour évaluer l'aléa « inondations fluviales »
- ☐ Méthodes pour évaluer l'aléa « submersion marine »
- ☐ Méthodes pour évaluer l'aléa « ruptures de digues »
- ☐ Méthodes pour évaluer d'autres types d'inondations
- ☐ Méthodes et outils pour évaluer les pertes de vies humaines et les dommages aux personnes (santé..) en cas d'inondation
- ☐ Outils permettant d'évaluer l'accessibilité du réseau routier pour les services d'urgence et la circulation générale en cas d'inondation
- ☐ Méthodes pour évaluer les trajets optimaux d'évacuation des zones inondées
- ☐ Outils pour évaluer les effets de l'amélioration de la diffusion des alertes inondations à la population
- ☐ Outils pour évaluer les dommages potentiels aux infrastructures sensibles (par ex : gaz, eau, centrales électriques, commissariats de police, hôpitaux)
- ☐ Méthodes pour évaluer les interactions possibles entre infrastructures sensibles
- ☐ Outils pour optimiser la localisation des zones d'accueil et d'hébergement en cas d'inondation
- ☐ Méthodes et outils pour évaluer les autres risques déclenchés par les inondations (effets domino, risques NaTech par ex. les risques qui pourraient résulter d'une inondation d'un complexe industriel)
- ☐ Méthodes pour évaluer la probabilité d'effondrement des bâtiments durant les inondations
- ☐ Autres outils utilisés – lister dans l'espace suivant

Continue



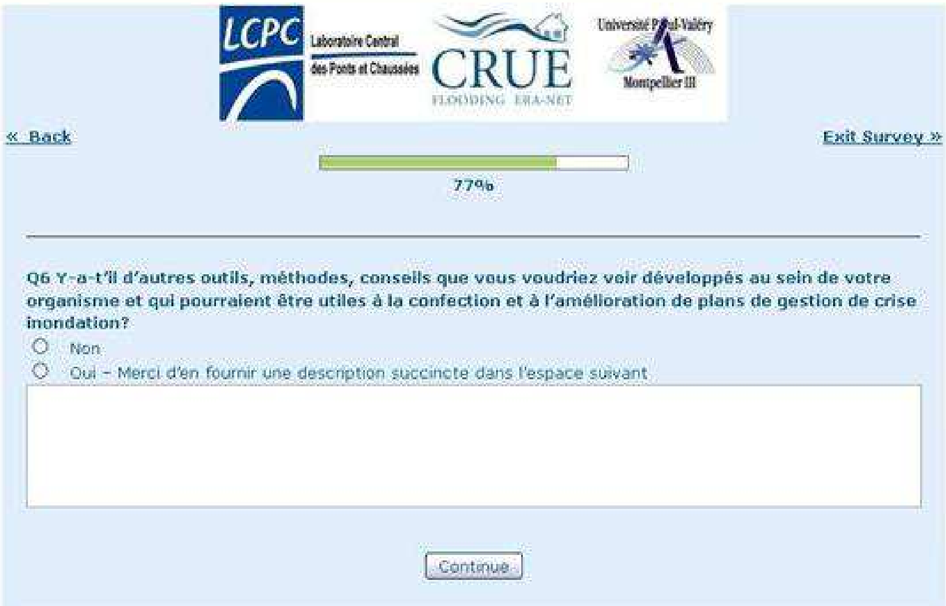
« Back

Exit Survey »

66%

Q5 Veuillez lister le nom des outils (guide, logiciel d'aide à la décision, méthodologie...) que vous utilisez ou dont vous disposez actuellement et qui sont utiles à l'élaboration des plans de gestion de crise inondation?

Continue



« Back

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77%

Q6 Y-a-t'il d'autres outils, méthodes, conseils que vous voudriez voir développés au sein de votre organisme et qui pourraient être utiles à la confection et à l'amélioration de plans de gestion de crise inondation?

- Non
- Oui – Merci d'en fournir une description succincte dans l'espace suivant

Continue

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88%

Q7 Parmi les outils et méthodes qui ne sont pas utilisés (par vous ou d'autres organismes) pour alimenter en information les Plans de gestion de crise inondations, veuillez indiquer la raison principale pour laquelle vous pensez qu'ils ne le sont pas. Si vous pensez que l'outil ou la méthode est déjà utilisé, veuillez cocher la case "actuellement utilisé"

	Actuellement utilisé	Pas pertinent pour les plans de gestion de crise	Méconnaissance de l'outil	Coût	Difficultés d'utilisation	Problème de disponibilité des données	Autres raisons
Evaluation de l'aléa inondation fluviale	○	○	○	○	○	○	○
Evaluation de l'aléa submersion marine	○	○	○	○	○	○	○
Evaluation de l'aléa par rupture de digue ou de barrage	○	○	○	○	○	○	○
Evaluation d'autres types d'inondation	○	○	○	○	○	○	○
Blessures et décès potentiels	○	○	○	○	○	○	○
Accessibilité des routes inondées par les véhicules	○	○	○	○	○	○	○
Trajets d'évacuations optimaux depuis les zones inondées	○	○	○	○	○	○	○
Réduction possible de la vulnérabilité des personnes associée à l'amélioration de la diffusion d'alerte	○	○	○	○	○	○	○
Dommages potentiels aux infrastructures dites sensibles	○	○	○	○	○	○	○

Méthodes pour évaluer les interactions possibles entre les infrastructures sensibles	○	○	○	○	○	○	○
Optimiser la localisation des abris en respect avec le risque inondation	○	○	○	○	○	○	○
Evaluation des autres risques déclenchés par les inondations (effet domino)	○	○	○	○	○	○	○
Probabilité de destruction des bâtiments par les inondations	○	○	○	○	○	○	○

Continue

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100%

Q8 Si vous avez d'autres commentaires que vous souhaiteriez faire à propos d'outils et méthodes qui pourraient améliorer les plans de gestion de crise inondation, veuillez les ajouter ci-dessous.

Continue

Merci pour le temps que vous avez accordé à cette enquête. Le rapport final du projet sera disponible sur le site web du projet www.fimframe.net en 2011. Cependant, des résultats intermédiaires au niveau du questionnaire devraient être disponibles au téléchargement sur le site web FIM FRAME en mai 2010. Pour de plus amples informations ou si vous souhaitez faire d'autres suggestions (votre avis détaillé nous intéresse), vous pouvez contacter Freddy Vinet par e-mail à l'adresse suivante : freddy.vinet@univ-montp3.fr ou Olivier Payrastre par e-mail à l'adresse suivante : olivier.payrastre@lcpc.fr.

Thank you for completing this survey

A3 The Netherlands survey

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10%

Geachte mevrouw, mijnheer,

Deze korte enquête (minder dan 10 minuten) vindt plaats in het kader van het Europese onderzoeksproject Flood Incident Management a FRAMEwork for improvement (FIM Frame, www.fimframe.net).
- Het FIM Frame project is onderdeel van het Europese onderzoeksprogramma ERA-NET CRUE (www.crue-eranet.net).
- Doel van het CRUE programma is het versterken van bestaande Europese onderzoeken m.b.t. overstromingsrisico, het promoten van 'best practices' en het identificeren van behoeftes en kansen voor toekomstige samenwerking tussen Europese landen.
- Het FIM Frame project wordt geleid door het Engelse onderzoeksinstituut HR Wallingford. Verder werken aan het project mee: Deltares (Nederland), Universiteit van Montpellier (Frankrijk) en Laboratoire Central des Ponts et Chausées (Frankrijk).

De doelen van het FIM Frame project zijn:
- Het evalueren van de effectiviteit en robuustheid van huidige rampenplannen voor overstromingen in Groot-Brittannië, Nederland en Frankrijk en het evalueren van methoden waarmee de plannen verbeterd kunnen worden.
- Het verkrijgen van overzicht van (potentiële) instrumenten (methoden, richtlijnen, handleidingen, software etc) die gebruikt worden bij het maken van rampenplannen en inzicht in en de meerwaarde van deze instrumenten bij het opstellen van de rampenplannen.
- Het bepalen hoe de beschikbare instrumenten gebruikt kunnen worden om rampenplannen te verbeteren en het identificeren van lacunes m.b.t. instrumenten.
- Het ontwikkelen van een kader (framework) te gebruiken om rampenplannen te verbeteren. Het kader zal getoetst worden binnen verschillende pilot gebieden in Nederland, Groot-Brittannië en Frankrijk.

Deze enquête wordt gehouden in het kader van het eerste en tweede projectdoel en moet inzicht geven in de informatie en instrumenten die kunnen bijdragen bij het opzetten van rampenplannen.

Wij waarderen het zeer indien u bereid bent deel te nemen aan deze enquête omdat uw inbreng erg waardevol voor ons zal zijn. Uw deelname aan deze enquête is geheel vrijwillig.

Uw antwoorden op de enquête vragen zijn anoniem. In aanvulling worden de resultaten gecodeerd. Met uw reacties zal vertrouwelijk worden omgegaan en resultaten van de enquête worden alleen gebruikt voor het FIM Frame project en door het FIM Frame projectteam. Indien u vragen hebt over de enquête of de procedure, dan kunt u contact opnemen met Karin Stone (karin.stone@deltares.nl) of Darren Lumbroso (d.lumbroso@hrwallingford.co.uk.).

Het invullen van deze enquête kost niet meer dan 10 minuten. Namens het projectteam dank ik u voor uw tijd. U kunt de enquête opstarten door op de 'Continue' knop te klikken.

Continue

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30%

In de enquête wordt de term 'rampenplan' gebruikt. Onder rampenplan wordt rampen- of crisisplannen en de onderliggende rampen- of crisisbestrijdingsplannen verstaan.

Q1. Bij welk type instituut bent u werkzaam?

- Onderzoeksinstituut
- Adviesbureau
- Waterschap
- Rijkswaterstaat
- Anders namelijk:

Q2 Produceert u (of collega's) vanuit uw werk informatie die ter ondersteuning *zou kunnen* dienen bij het maken van rampenplannen voor overstromingen?

- Ja
- Nee
- Onduidelijk

Continue

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40%

Q3 Produceert u (of collega's) vanuit uw werk *momenteel al* informatie die ter ondersteuning dient bij het maken van rampenplannen voor overstromingen?

- Ja
- Nee
- Onduidelijk

Continue

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50%

Q4 Welke van onderstaande methodes en/of tools zijn naar uw mening nuttig of gebruikt u nu al ter ondersteuning bij het maken van rampenplannen voor overstromingen? Meerdere antwoorden mogelijk.

	"Niet nuttig"	"Nuttig"	"Ggebruikt bij plannen"
Methoden om overstromingsdreiging vanuit rivieren te bepalen	○	○	○
Methoden om overstromingsdreiging vanuit zee te bepalen	○	○	○
Methoden en instrumenten om potentiële slachtoffers te bepalen	○	○	○
Methoden en instrumenten om potentiële schades te bepalen	○	○	○
Methoden en instrumenten om risico's te bepalen	○	○	○
Instrumenten om bereikbaarheid/berijdbaarheid /beschikbaarheid van geïnundeerde wegen voor hulpdiensten en andere voertuigen te bepalen	○	○	○
Instrumenten om optimale evacuatie routes te bepalen	○	○	○
Methoden en instrumenten om de effecten van verbeterde waarschuwing en risico communicatie te bepalen	○	○	○
Methoden en instrumenten om de potentiële schade aan vitale infrastructuur te bepalen bv. gas, water, elektriciteit, communicatie netwerk, hulpdiensten stations etc.)	○	○	○
Methoden en instrumenten om afhankelijkheid van verschillende vitale	○	○	○

Methoden om overstromingsdreiging vanuit zee te bepalen	○	○	○
Methoden en instrumenten om potentiële slachtoffers te bepalen	○	○	○
Methoden en instrumenten om potentiële schades te bepalen	○	○	○
Methoden en instrumenten om risico's te bepalen	○	○	○
Instrumenten om bereikbaarheid/berijdbaarheid /beschikbaarheid van geïnundeerde wegen voor hulpdiensten en andere voertuigen te bepalen	○	○	○
Instrumenten om optimale evacuatie routes te bepalen	○	○	○
Methoden en instrumenten om de effecten van verbeterde waarschuwing en risico communicatie te bepalen	○	○	○
Methoden en instrumenten om de potentiële schade aan vitale infrastructuur te bepalen bv. gas, water, elektriciteit, communicatie netwerk, hulpdiensten stations etc.)	○	○	○
Methoden en instrumenten om afhankelijkheid van verschillende vitale infrastructuur systemen te beoordelen	○	○	○
Instrumenten om shelter of opvang locaties te optimaliseren	○	○	○
Methoden en instrumenten om keten effecten van overstromingen te bepalen (Bv. chemische ramp a.g.v. overstroming)	○	○	○
Methoden om instortingsgevaar van gebouwen bij een overstroming te evalueren	○	○	○

Continue


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70%
Q5 Kent u andere methodes en instrumenten die nog niet in bovengenoemde lijst staan waarvan u denkt dat zij nuttig kunnen zijn of die u nu al gebruikt ter ondersteuning voor het opstellen van rampenplannen.
Nee
Ja, namelijk:
Q6 Zijn er methodes, instrumenten en/of informatie die u graag ontwikkeld zou willen zien ter ondersteuning bij het opstellen van rampenplannen voor overstromingen?
Nee
Ja, namelijk:
Continue

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80%

Q7 Geef voor de onderstaande informatie de belangrijkste reden aan waarom ze momenteel NIET worden gebruikt voor het opstellen van rampenplannen voor overstromingen. Indien ze naar uw mening wel worden gebruikt, kunt u de box 'gebruikt' aanvinken.

	Gebruikt	Wel gebruikt, maar niet voldoende	Niet relevant voor rampenplannen	Onbekendheid met methode	Kosten	Gebruikers vriendelijkheid	Data beschikbaarheid	Andere redenen
Dreigingsbeeld vanuit de rivier	○	○	○	○	○	○	○	○
Dreigingsbeeld vanuit zee	○	○	○	○	○	○	○	○
Potentiële slachtoffers	○	○	○	○	○	○	○	○
Potentiële schades	○	○	○	○	○	○	○	○
Risico beelden	○	○	○	○	○	○	○	○
Toegankelijkheid geïnundeerde wegen	○	○	○	○	○	○	○	○
Optimale evacuatieroutes	○	○	○	○	○	○	○	○
Effecten van verbeterde risicocommunicatie en waarschuwing	○	○	○	○	○	○	○	○
Potentiële schade aan kritieke infrastructuur	○	○	○	○	○	○	○	○
afhankelijkheid van verschillende vitale infrastructuur systemen	○	○	○	○	○	○	○	○
Optimale shelter en opvang locaties	○	○	○	○	○	○	○	○
Keteneffecten	○	○	○	○	○	○	○	○
Instortingsgevaar gebouwen	○	○	○	○	○	○	○	○

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100%

Q8 Heeft u nog aanvullingen op deze lijst?

- ○ Nee
- ○ Ja, namelijk: (Geef ook aan waarom deze informatie niet gebruikt wordt)

Q9 Indien u nog aanvullingen heeft over instrumenten (methoden, richtlijnen, handleidingen, software etc) die naar uw idee kunnen bijdragen aan het verbeteren van rampenplannen voor overstromingen, dan kunt u deze in onderstaande box geven.

Continue

Hartelijk dank voor uw tijd. De definitieve project resultaten zullen in 2011 beschikbaar komen op de project website (www.fimframe.net). Resultaten van deze enquête zullen vanaf mei 2010 via de project website beschikbaar gesteld worden. Voor vragen en informatie kunt u ook contact opnemen met Karin Stone (karin.stone@deltares.nl) of de project coördinator Darren Lumbroso (d.lumbroso@hrwallingford.co.uk).

Thank you for completing this survey

Appendix B Details of the survey of flood managers in England and Wales

B1 Review of the England and Wales flood managers survey

B1.1 Introduction

The survey was sent solely to staff in the Environment Agency who were believed to be involved in contributing towards MAFPs. There were 53 responses to the Environment Agency survey of which 39 completed all of the survey. Table B1 provides the responses by Environment Agency Region.

B1 Environment Agency responses

Environment Agency Region	Percentage of responses received
Anglian	15.1%
Midlands	13.2%
North East	11.3%
North West	5.7%
Southern	13.2%
South West	9.4%
Thames	20.8%
Welsh	11.3%
Head Office	0.0%

Of the 53 responses that were received 44 of the responders stated that they were currently involved in producing information that may be used by Local Resilience Forums in formulating Multi Agency Flood Plans. With eight stating they were not involved in producing information that could assist with MAFPs and the rest stating that they "didn't know".

B1.2 Tools, methods and guidelines currently used in England and Wales

The flood incident management teams at the Environment Agency were asked about what tools, methods or guidelines that they were aware of or currently used that could contribute to the formulation of Multi Agency Flood Plans (MAFPs). The results are summarised in Table B2.

Table B2 Percentage of responders in England and Wales who use or are aware of methods that contribute to Multi Agency Flood Plans

Tool, method or guidelines	Percentage of responders who use or are aware of method
Fluvial floods hazard	98%
Coastal floods hazard	80%
Flood hazard from dam failures	58%
Hazard from other sources of flooding	58%
Accessibility of inundated roads	53%
Optimisation of the location of shelters	51%
Damage to critical infrastructure	49%
Optimal evacuation routes	42%
Effects of improvements in flood warning on the risk to people	40%
Methods to assess potential injuries and loss of life	36%
Inter-dependency of critical infrastructure	18%
Other methods	18%
Tools to assess other hazards triggered by floods	13%
Methods to assess the probability of building collapse	2%

Table B2 clearly shows that there is a good awareness of methods to assess the flood hazard from rivers and to a slightly lesser degree from the coast. When asked to list the names of the tools, methods or guidance that the flood managers used the response could be group under the following headings:

i. Flood maps and hydraulic models – 41 responses
ii. Multi-Agency Flood Plan guidance and checklist – 27 responses
iii. Flood warnings – 20 responses
iv. Receptors vulnerable to flooding – 8 responses
v. Flood Risk Assessment Guidance for New Development FD2320 and Planning Policy Statement related documents – 6 responses
vi. Flood defences – 5 responses
vii. Previously written plans – 5 responses
viii. Critical infrastructure – 2 responses
ix. Others

There were 41 responders who mentioned the use of specific mapping products or hydraulic models such as ISIS, Tuflow, JFLOW and THEMIS. A number of responders mentioned the use of they used the new Surface Water Flood Map as well as reservoir inundation maps and plans. One responder stated the following:

"*Within the Development and Flood Risk Section which deals primarily with Planning Applications and Flood Defence Consent Applications we have access to a number of Agency hydraulic models of rivers providing various return period flood levels together with the associated mapping. Reservoir inundation maps. Strategic Flood Risk Assessments (SFRAs) produced by all of the District Councils that should consider all forms of flooding, these will incorporate the Ageny's web based flood plain detail Flood Zones 1,2 and 3, these are classed as Level 1 SFRAs, in addition to these there will be a small number of Level 2 SFRAs that will provide individual models of specific flooding areas, for example where regeneration areas are highlighted through Local Development Frameworks.*"

Flood plain mapping and hydraulic modelling are both "mature sciences" in the UK with the Environment Agency undertaking tens of millions of pounds worth of mapping studies and modelling exercises since it was formed in 1996. As a consequence it is understandable that most of the responders are familiar with the flood mapping outputs, tools and models

It was interesting to note that although relative new documents there were 27 responders who stated that they used the Multi Agency Flood Plan guidance and checklist to help them

What is interesting from the response is that very few and in some cases no responders to the survey explicitly mentioned tools that would cover the following:

- Accessibility of inundated roads
- Optimisation of the location of shelters
- Damage to critical infrastructure
- Optimal evacuation routes
- Effects of improvements in flood warning on the risk to people
- Methods to assess potential injuries and loss of life

However, in their many responders stated that they used these methods to inform Multi-Agency Flood Plans in England and Wales.

B1.3 Obstacles to the use of tools, methods and guidelines relevant to emergency planning in England and Wales

As part of the survey the flood incident managers were about the current usage of certain tools to inform Multi Agency Flood Plans. The stakeholders were asked if they current used the tools and if not to classify the reason why not into one of the following:

- Not relevant to Multi-Agency Flood Plans;
- Unaware of the method;
- Cost
- User friendliness issues;
- Availability of data;
- Other reasons.

The results of the survey are given in Tables B3 and B4. Of the methods the methods currently stared to be used by responders to the survey ranked as follows:

Fluvial floods hazard	88.6%
Coastal floods hazard	70.6%
Hazard from other sources of flooding	51.5%
Optimal evacuation routes	45.7%
Improvements in flood warning on the risk to people	45.7%
Flood hazard from dam failures	42.9%
Optimisation of the location of shelters	42.9%
Accessibility of inundated roads	31.4%
Damage to critical infrastructure	29.4%
Methods to assess potential injuries and loss of life	14.3%
Assessment of other hazards triggered by floods	11.4
Methods to assess the probability of building collapse	0.0%

Table B3 Response to the usage of tools to inform Multi-Agency Flood Plans by the Environment Agency – Part 1

Current usage of tools to inform Multi-Agency Flood Plans (% of responders)	Methods to assess flood hazard from				Potential injuries and loss of life	Accessibility of inundated roads to vehicles
	Fluvial	Coastal	Dams	Other sources		
Currently used	88.6%	70.6%	42.9%	51.5%	14.3%	31.4%
Reasons given if not currently used						
Not relevant to plans	0.0%	20.6%	5.7%	3.0%	5.7%	0.0%
Unaware of method	5.7%	2.9%	11.4%	9.1%	62.9%	48.6%
Cost	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%
User friendliness issues	2.9%	2.9%	2.9%	6.1%	0.0%	5.7%
Availability of data	0.0%	0.0%	22.9%	24.2%	14.3%	11.4%
Other reasons	2.9%	2.9%	14.3%	3.0%	2.9%	2.9%

Table B4 Response to the usage of tools to inform Multi-Agency Flood Plans by the Environment Agency – Part 2

Current usage of tools to inform Multi-Agency Flood Plans (% of responders)	Optimal evacuation route(s) from inundated areas	Effects of improvements in the dissemination of flood warnings on the risk to people	Potential damage to critical infrastructure	Optimising the locations of shelters with respect to floods	Assessment of other hazards triggered by flooding	Probability of buildings collapsing during floods
Currently used	31.4%	45.7%	29.4%	42.9%	11.4%	0.0%
Reasons given if not currently used						
Not relevant to plans	0.0%	5.7%	0.0%	0.0%	2.9%	3.0%
Unaware of method	57.1%	34.3%	35.3%	40.0%	68.6%	72.7%
Cost	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
User friendliness issues	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Availability of data	8.6%	5.7%	35.4%	11.4%	8.6%	24.2%
Other reasons	2.9%	8.6%	0.0%	5.7%	8.6%	0.0%

B1.3.1 Unaware of method

The main reason for the lack of use of tools such as: methods to assess loss of life; optimisation of evacuation routes and shelters; assessment of other hazards triggered by floods; and the probability of building collapse were stated to be "unawareness of the method".

Typical replies indicating that there is a lack of awareness of exactly what tools are available.

"I'm not sure what you meant by any of this really. Where we have ways and means locally of determining the information you refer to I have considered that to be a tool we use but the wording of this survey implies there are specific nationally developed tools and models out there to delver the information. If this is the case most my answers would be that I am not aware of the tool!"

"*There are no dedicated tools or methods employed beyond standard Environment Agency datasets such as Flood Map*."

"*Educate all Environment Agency staff involved with MAFPs about what tools are available to us to help us with the plans and share best practice between areas*".

"*There may be guidance, methods, or tools in existence that I am unaware of. If so it might be good to give training on these tools, have best practice sessions with colleagues or at least produce a comprehensive internal brief on the help that is available to assist in producing MAFPs*."

"*Many of the issues raised are complex. In an ideal world, with unlimited resource we would do "a bells and whistle's job on MAFPs, we do not live in that world, we use the tools we have, and we make inferences and judgments. Many of the 'tools' referred to [in the survey] do not exist, which makes deciding if we use them difficult, as we do make reasoned decisions based on data sets, but is this a tool? We also load our time to the highest risk communities, so some get more time put to them than others, and all MAFPs are live documents and will develop with time, we use the tools we have at each iteration*."

B1.3.2 Availability of data

Availability of data was seen to be an issue mainly with regards to assessing potential damage to critical infrastructure; flooding from other sources; dam failure and the probability of building collapse. One responder noted that:

"*Focus needs to be on particular sections within flood plans which are proving difficult to write, in particular the inclusion of information on critical local infrastructure. We desperately need some form of guidance on how to include this information and what level of detail to include. At the moment these sections are being omitted due to lack of information from infrastructure owners and poor understanding of how to include the information when it has been supplied*."

B1.3.3 Friendliness

User friendliness was not seen by the responders.

B1.3.4 Cost as an obstacle

It is interesting to note that cost was not seen as a major constraint for the implementation of the methods. There was just one method where cost was quoted as an issue

B1.3.5 Not relevant to plan

Very few users indicated that the methods listed in the survey were not relevant to MAFPs. For the assessment of coastal flooding some 20% of responders stated that the method was not relevant;

however, this likely to be because the flood mangers who responded to this question are based in an area where there is no coastal flooding.

B2. Are there any other tools, methods or guidance that you would like to see developed that could be used by Local Resilience Forums to develop Multi Agency Flood Plans?

Identification of critical /essential local infrastructure
Guidance on safe evacuation - what is safe - what is acceptable and for who - also clarification of who's responsibility it is to comment/object to new development proposals that are dependent on evacuation by third parties etc.
Joint probability of flooding form differing sources - fluvial/pluvial/tidal
Joint probability - pluvial/fluvial/tidal in areas at risk of each
More definite guidance on how the MAFP is structures. For example my two LRFs write their MAFPs based on EA flood warning areas, but I know this is not the case in other LRFs. I would appreciate a definite decision on how the MAFP should be structured to minimise confusion and double handling with EA LFWPs.
Guidance to differentiate depending on the size of the authority I;e. Greater Manchester produced a strategic level plan and the individual boroughs produced tactical/operation response plans. So there needs to be guidance for strategic plans and guidance for Operational Plans
Guidance on Plan Activation and the escalation routes to activate the plan
Guidance on Mutual and Military Aid
Guidance on how areas should conduct the risk assessment section on the Community Flood Risk Summary sheet
Guidance on differentiation between strategic MAFPs for County level plans and tactical/response plans at a more local level
Further guidance on carrying out the risk assessments
Guidance on plan activation and escalation (who does it and what is the mechanism)
Guidance on Mutual Aid procedures (how are they implemented and how are they overseen at a strategic level)
Guidance on MACA (implementation and management)
Tools to assess damage (and financial cost) caused by inundation (may already exist but I am not aware of it)
A tool to guide developers, applicants on suitable flood warning and evacuation plans for different types of development and occupants vulnerability, i.e. caravans, affordable housing, care homes etc.
Reservoir inundation information when released.
Revised information on critical infrastructure especial along the lines of what is critical as it varies depending on the situation and the opinion of the owner. An agreement to share information as some companies are still unwilling to share information and inform as to which parts of their structure are critical as for example not every substation is critical.
Better guidance as to what is a satisfactory plan with possible mandatory sections because currently it is down the LRF to put in what they see fit. The structure etc in the guidance are suggestion and so it can be hard to get LRF to include all the relevant information."
Flood visualisation
some professional partners have lists of vulnerable people that are data protected i.e. those that require regular medical treatment this would help during major flood events for evacuation etc.
Assessment of risk of injury during evacuation against risk of injury due to flooding if not evacuated.
Assessment of lead time needed to enable safe evacuation of communities."
Flood visualisation - this would be useful for responders to see the areas that could be affected and plan their response appropriately.
Tools, methods or guidance on how to include in flood plans the vulnerability of local critical infrastructure, including identifying key points of failure. There needs to be an agreement on how this information can be published in the flood plan with permission of the infrastructure owners.
Very hard to acquire but more information on critical infrastructure and their likelihood of flooding would be very beneficial to emergency responders. This data at the moment is very sparse.

I found the guidance which was produced to be used in the preparation of the Multi Agency Flood Plan to be very vague. I would have liked to see some sort of template to follow.
Templates/more detailed examples of maps, what needs to be shown on them.
LRFs have requested clearer guidance on MAFPs
We deal with Local Resilience Forums on applications for new development and my experience is they look at new development in isolation rather then taking a position we have enough problems we don't want to put any additional burden on the emergency services
Some kind of online forum, website - possibly the NRE to share best practice between LRFs demonstrating examples of "satisfactory" plans.
Methods of sharing confidential data at short notice
Flood depth estimation system could be developed into a really good visualisation tool
More guidance on what agencies/ organisations should be producing/ contributing to each section - this will help us with asking the LRF's to produce these.
Clearer guidance from the Government over the production, implementation and practicing of Flood Plans.
Details of issues to consider and how plans are formulated would be useful. At present the local authority Emergency Planners appear to struggle to interpret the outputs SFRAs and implement the findings.
Greater consideration of flooding in the field of Emergency Planning would be beneficial.
It would be good to see tools and methodologies developed for the areas of interest listed as a checklist in a previous question.
Improved flood visualisation tools
Secure website for data sharing within LRF and live reporting between Bronze Silver and Gold Command

Please list the names of the tools, methods or guidance that you currently use that are of assistance to Local Resilience Forums in producing Multi Agency Flood Plans?

The responders were asked the above question. Their responses could be broadly grouped under the following headings:

- Flood maps, mapping products and hydraulic models
- Flood Risk Assessment Guidance for New Development FD2320 and PPS related documents
- Flood Warning related tools
- Multi-Agency Flood Plan Guidance
- Flood defences
- Critical infrastructure
- Receptors vulnerable to flooding
- Historical information
- Previously written plans
- Others

The full list of replies grouped under these headings is given below.

Flood maps, mapping products and hydraulic models
Environment Agency (EA) Flood Maps (ISIS, Tuflow, JFLOW mathematical models)
Surface water flooding maps
Reservoir inundation maps
Flood map
ISIS
TUFLOW
THEMIS - local flooding inundation modelling software"
No dedicated tools or methods employed beyond standard EA datasets such as Flood Map.
THEMIS, ISIS
Flood mapping/GIS: flood modelling (including hazard mapping), reservoir flood maps, areas susceptible to surface water flooding maps
EA flood maps

Mapping products (Flood depth, flow velocity, flood hazard, blockage scenario, over-topping, Areas Benefitting from defences, Standards of protection, Address Point data, Digital Terrain modelling)
EA Flood Map and other associated risk maps etc.
LFWP, Flood Outlines, depths and velocity models, Dorset Explorer,
Outputs from Area Strategic Mapping & Modelling projects. Flood Map, Surface Water Flood Map, Reservoir Inundation Map and historic information"
Flood Map
The Flood Map
EasiMap
Properties at risk in the 1 in 100 and 1000 year outline
River modelling, tidal modelling, surface water maps, dam breach flood flows
GIS - flood zones, lidar, other topographic data, SFRAs, CFMPs, mapping studies
Flood Maps
Reservoir inundation maps, reservoir off site plan guidance
We already have a Multi Agency Flood Plan and the LRF have commented that the most useful thing is the maps which contain the flood warning areas and other critical and vulnerable infrastructure.
Surface Water Flooding Map
EA flood zones
Surface Water Flooding Map
Reservoir Inundation Maps
Reservoir Plans
Environment Agency's flood zone maps and detailed modelling
Surface Water Flooding Maps
Outputs from Area Strategic Mapping and Modelling projects. Flood Map, Surface Water Flood Map, Reservoir Inundation Mapping
Flood maps, Surface Water Flooding Maps.
OS master map data
Flood spreading animations
Within the Development and Flood Risk Section which deals primarily with Planning Applications and Flood Defence Consent Applications we have access to a number of Agency hydraulic models of rivers providing various return period flood levels together with the associated mapping. Reservoir inundation maps. Strategic Flood Risk Assessments (SFRA's) produced by all of the District Councils that should consider all forms of flooding, these will incorporate the Agony's web based flood plain detail Flood Zones 1,2 and 3, these are classed as Level 1 SFRA's, in addition to these there will be a small number of Level 2 SFRA's that will provide individual models of specific flooding areas, for example where regeneration areas are highlighted through Local Development Frameworks.
GIS (Map Info, ArcView)
Flood Survey, Maps and experience of previous events
ARC Map - flood warning areas
Areas susceptible to surface water flooding,
Lidar

Flood Risk Assessment Guidance for New Development FD2320 and PPS related documents
Flood Risk Assessment Guidance for New Development FD2320
Defra guidance FD2320 and FD2321 which gives guidance on assessing flood hazard, a
Defra/EA report FD2320
FD2320/TR2 from the PPS25 Practice guide
PPS25 companion guide
PPS25 and supporting practice guide

Flood Warning related tools
Flood Warning Direct (FWD)
Flood Warning Areas
EA Local Flood Warning Plan
Local flood warning plans, FWD

Floodline Warnings Direct
Environment Agency Local Flood Warning Plans
EA Flood Warning Areas
local flood warning plans
EA Flood Warning Areas
Local Flood Warning Plan
Local flood warning plans.
EA Local Flood Warning Plans
Flood warnings direct
EA Local Flood Warning Plans
Flood Warning Area Shapefiles
Propserties at risk in the Flood Warning Areas
Local Flood Warning Plans (LFWP)
LFWPs
LFWPs
EA Flood Warning procedures and operational procedures

Multi-Agency Flood Plan Guidance
Defra guidance and checklist produced in 2009
Multi-Agency Flood Plan Guidance, checklist
MAFP guidance from DEFRA
MAFP guidance and templates
LMAFP template produced locally
DEFRA multi agency flood plan check list
Defra checklist guidance
Defra MAFP guidance
Preliminary guidance - Developing a Multi-agency flood plan produced by the Civil Contingencies Secretariat and use of the templates contained within
Emergency Prepardness (Civil Contingencies Act) including plan templates & guides.
Flood Warning & Operational Manuals
Defra MAFP guidance
Preliminary DEFRA guidance was followed.
Guidance documents include DEFRA flood guidance
Defra/EA Multi Agency Flood Plan Guidance and Checklist for Multi Agency Flood Plans
Developing a Multi Agency Flood Plan Guidance for Local Resilience Forums and Emergency Planners, Checklist for Multi Agency Flood Plans, Templates, Figures and Tables for Developing a Multi Agency Flood Plan
Developing a Multi-Agency Flood Plan (MAFP) - Guidance for Local Resilience Forums and Emergency Planners
Defra Guidance on MAFPs
Civil Contingencies preliminary guidance for MAFP's
Checklist for Multi-Agency Flood Plans (MAFP)
Multi-Agency Flood Plan Guidance Templates, Figures and Tables
Defra guidance
Auditing the MAFP in our are using the new multi agency flood plan checklist.
Civil Contingencies Secretariat (CCS) Guidance
CCS Guidance
Emergency Response and Recovery Guidance
Generic LRF and County level emergency Planning guidance

Flood defences
Defences - National Flood and Coastal Defence Database (NFCDD)
NFCDD
Areas benefiting from defences map - NFCDD
EA Defences

Defences in place

Receptors vulnerable to flooding
Receptors Vulnerable to Flooding Data
Receptors Vulnerable to Flooding
Receptors Vulnerable to Flooding
Vulnerable locations/people data (EPU)
Receptors vulnerable to flooding database
Receptors vulnerable to flooding information (key infrastructure in GIS format)
Receptors vulnerable to flooding
Community Risk Register

Critical infrastructure
Critical infrastructure
Critical infrastructure location maps - lists from utility companies

Historical information
Historic information and local knowledge held by all multi-agency partners
EA flood history - where known
History of flooding for each flood warning area
Historic flood info
Historic flooding

Previously written plans
Existing County/District/Borough Emergency Plans
Flood Plans from other LRFs demonstrating best practice
Previous written plans
LRF floods action plans
Existing LA operational and tactical plans etc

Others
Gauge board sheets for triggers
Through the planning process a number of Flood Risk Assessments(FRA's) are submitted in support of planning applications, some of these are undertaken to the Agency's standard which enables the web base information to be uprated,
Strategic Flood Risk Assessments
Site specific Flood Risk Assessments
Reservoir register
Rapid Response Catchment Plans
Outputs from FFC & Met Office (weather statements & heavy rainfall warnings etc.)
Time to peak information - from forecasting information
EA Operational procedures
Data and information held by all Cat1 & Cat 2 Responders
Properties signed up to the Floodline Warnings Direct Service for each Borough/District area.
Strategic Flood Risk Assessments, Site specific flood risk assessments, Local Drainage Groups
Strategic and site specific Flood Consequence Assessments
Civil Contingencies Act
LRF risk assessments for flooding
Local EA Area staff knowledge
Pitt Report,
Flood Exercises, - lessons learnt etc.
Sharing info between partners in MA sessions to produce the plans.

Other comments

Educate all EA staff involved with MAFPs about what tools are available to us to help us with the plans

Share best practice between areas

There may be guidance, methods, or tools in existence that I am unaware of (I have only been in EA for a year). If so it might be good to give training on these tools, have best practice sessions with colleagues or at least produce a comprehensive internal brief on the help that is available to assist in producing MAFPs.

The tools need to be simple and generic so they can be applied throughout the country in a consistent manner. Information gaps also need to be identified and a process highlighted how they can be filled and by what organisation, i.e. hazard mapping by the EA.

One of the key challenges on the east coast (or in any defended tidal areas) is to establish a proportionate and appropriate emergency response for breach scenarios. Determining the probability of breach is a key issue as is the time to call for evacuation. It would be helpful if consideration can be given to the dilemma of either evacuating too early, and early signs of a potential breach occurring don't materialise, as opposed to waiting until there are more definite signs that a breach will actually occur and this being too late to enable safe evacuation of communities immediately behind the defences, and before dangerous flooding happens. Guidance on the different parameters at play, the thought process needed, decision elements and a suitable process would be very helpful. (How do we try to avoid 'crying wolf' too often?) Happy to discuss further/assist with this consideration/process work if required.

There is good generic guidance on requirements for a flood plans. Focus needs to be on particular sections within flood plans which are proving difficult to write, in particular the inclusion of information on critical local infrastructure. We desperately need some form of guidance on how to include this information and what level of detail to include. At the moment these sections are being omitted due to lack of information from infrastructure owners and poor understanding of how to include the information when it has been supplied.

I'm not sure what you meant by any of this really. Where we have ways and means locally of determining the information you refer to I have considered that to be a tool we use but the wording of this survey implies there are specific nationally developed tools and models out there to delver the information. If this is the case most my answers would be that I am not aware of the tool!

Multi Agency Flood Plans suit LRFs that are composed of one county but are not very well suited to the Thames Valley LRF which is made up of three counties and Milton Keynes. The MAFP was written at strategic gold level and linked closely to the Local Flood Warning plans which anup-to-date and well liked by both Cat 1 and 2 responders.

Often the information held by local authorities is not used to inform Flood Plans or to assist the Local Resilience Forum in making decisions. The information contained in Strategic Flood Risk Assessments appears to often just be used by the Spatial Planners and not Emergency Planners.

An understanding of the sequence of events during a flood, what the impacts on people and buildings will be and the longer term implications will be essential."

This is a terrible survey; I would not use the outputs from this to make decisions.

Many of the issues raised are complex. In an ideal world, with unlimited resource we would do “a bells and whistles” job on MAFPs, we do not live in that world, we use the tools we have, we make inferences and judgments. Many of the 'tools' referred to do not exist, which makes deciding if we use them difficult, as we do make reasoned decisions based on data sets, but is this a tool? We also load our time to the highest risk communities, so some get more time put to them than others, and all MAFPs are live documents and will develop with time, we use the tools we have at each iteration.

Appendix C Details of the survey of flood managers in France

C1 Review of the French flood managers' survey

There were a total of 77 people who commenced the survey and a total of 31 fully completed responses. The survey was distributed to various organisations responsible for flood management including the Direction régionale de l'environnement, de l'aménagement et du logement (DREAL) and Direction départemental des territoires (DDT). Details of the location of the responses are displayed in Table C1. Around 75% of responders are involved in producing information that may be used in emergency plans. Table C2 gives the percentage of responders in France who use or are aware of methods that contribute to emergency plans.

Table C1 Geographical origin of responders to the flood manager survey

Region	Number of responses
Alsace	2
Aquitaine	5
Auvergne	2
Basse-Normandie	1
Bourgogne	1
Bretagne	0
Centre	6
Champagne-Ardenne	2
Collectivités et territoires d'Outre-Mer	0
Corse	0
Départements d'Outre-Mer	0
Franche-Comté	0
Haute-Normandie	4
Ile-de-France	4
Languedoc-Roussillon	1
Limousin	1
Lorraine	2
Midi-Pyrénées	3
Nord-Pas-de-Calais	1
Pays de la Loire	4
Picardie	1
Poitou-Charentes	2
Provence-Alpes-Côte-d'Azur	2
Rhône-Alpes	7

Table C2 Percentage of responders in France who use or are aware of methods that contribute to emergency plans

Tool, method or guidelines	Percentage of responders who use or are aware of method
Fluvial floods hazard	98%
Flood hazard from dam failures	43%
Hazard from other sources of flooding	38%
Accessibility of inundated roads	33%
Effects of improvements in flood warning on the risk to people	30%
Damage to critical infrastructure	23%
Optimisation of the location of shelters	20%
Coastal floods hazard	18%
Methods to assess potential injuries and loss of life	18%
Others	18%
Inter-dependency of critical infrastructure	13%
Tools to assess other hazards triggered by floods	10%
Optimal evacuation routes	8%
Methods to assess the probability of building collapse	5%

Table C2 shows the percentage of responders who are aware or who use tools to assess different items in flood management plans. Most of the people who filled in the survey were aware of methods used to assess fluvial flood hazard. This is the most widespread type of flood in France and all the French regions are prone to this kind of flood. Flood hazards from dam failure ranked second. This may be due to the recent reinforcement of legal requirements relating to dam security in France. Tools concerning the assessment of flood hazard are clearly dominant except for coastal flooding. Unlike in the Netherlands and in England and Wales, coastal floods had never been considered as a relevant problem in France. However, the recent sea surge in western France that killed about 50 people on 28 February 2010 ought to change the point of view of authorities on this problem. Only one responder out of 5 was aware or used tools to assess damage or potential impacts of flood events (i.e. methods to assess potential injuries and loss of life; damage to critical infrastructure). The lack of dissemination of tools to assess the impacts on flood or to assess potential damages has already been pointed out in many articles and reports in France. (Hubert & Ledoux, 1999) Only 10 % of flood managers mentioned “Tools to assess other hazards triggered by floods”. Natechs are not really addressed in France. Technological and natural hazards still are dealt separately. However some services in charge with flood management use *methods to evaluate the cost of the damage at large scales (departmental, regional)* and *tools to evaluate the potential damage in farms.*

Tables C3 and C4 confirmed this trend. These Tables display the results of question 6 : “For the tools and methods that are NOT being used to inform flood emergency management plans by you or other organisations please indicate the main reason why you think they are not used. If you think the tool or method is currently being used please tick the "Currently used" option.”. Except for tools used in the assessment of coastal floods (which is linked to the geographical context of the regions as all the regions have not got seaside), the irrelevancy of proposed methods is not pointed out. The two main reasons why tools or methods are not used are first unawareness of the tools and the second is the lack of data.

Unaware of tool
Tools to evaluate flood hazards are the most disseminated ones. It is linked to the competencies of services. There has been a single minded focus on the knowledge of hazard. International organisations admit now that one must shift from a pure knowledge of hazards to an integrated assessment and management of the risk (Hutter, 2006).

The awareness of the existence of tools is low for tools that help to evaluate the impacts: potential injuries and loss of life, probability of buildings collapsing during floods and for tools or methods that can help organizing the emergency (e.g. optimising the locations of shelters) (more than half of responders don't know any tools linked to the item)**.** Scores are high for tools assessing the potential triggering of risk after a flooding (NaTech). However, for tools related to the evaluation of road networks availability during an emergency, the awareness is better: only about 30% to 40% of responders state that they do not know any tools.

Availability of data
For the methods to inform dam failure plans, the lack of data clearly appears. This problem is being addressed by the French Ministry of Ecology. For tools helping in assessing potential disruptions caused by floods e.g. *Potential damage to critical infrastructure, Accessibility of inundated roads to vehicles flood,* the number of response "availability of data" is high. That means the tools are known by a part of the responders but the lack of data to inform those tools is a constraint. So for the management of networks (road), or for Natech risks, responders know that tools exist. There is a room for improvement in the use of such tools providing accurate data.

Cost
Thus, as a paradox, the cost is not selected as an obstacle for the use of tools. We should have asked whether the cost of data (instead the cost of the tools) is a real bottleneck. Most of the time, data to inform the tool is more expensive than the tool itself. We also can wonder how the lack of available data is a consequence of the cost of the building of databases.

General comments
The tools that are researched are between the knowledge of Risk and the real time forecast. A responder describes this "missing link" as "*the tools making it possible to work on the forecast of the floods, intermediate link between knowledge of the risk for the PPR (land use planning) and the forecast of the flood! It is about a step engaged by the ministry and we will compel the departments to develop this function!* Some responders contact us by email and told that they were expecting for the results of the survey because the question were very "concrete".

Table C3 Response to the usage of tools to inform emergency plans in France – Part 1

Current usage of tools to inform emergency plans (% of responders)	Methods to assess flood hazard from				Potential injuries and loss of life	Accessibility of inundated roads to vehicles
	Fluvial	Coastal	Dams	Other sources		
Currently used	100%	44%	50%	38%	5%	20%
Reasons given if not currently used						
Not relevant to plans	0%	17%	0%	10%	5%	0%
Unaware of method	0%	17%	14%	24%	68%	35%
Cost	0%	0%	5%	0%	0%	0%
User friendliness issues	0%	0%	5%	5%	5%	0%
Availability of data	0%	6%	23%	19%	11%	40%
Other reasons	0%	17%	5%	5%	5%	5%

Table C4 Response to the usage of tools to inform emergency plans in France – Part 2

Current usage of tools to inform emergency plans (% of responders)	Optimal evacuation route(s) from inundated areas	Effects of improvements in the dissemination of flood warnings on the risk to people	Potential damage to critical infrastructure	Optimising the locations of shelters with respect to floods	Assessment of other hazards triggered by flooding	Probability of buildings collapsing during floods
Currently used	16%	26%	17%	24%	11%	6%
Reasons given if not currently used						
Not relevant to plans	0%	0%	0%	0%	0%	0%
Unaware of method	47%	53%	56%	59%	53%	56%
Cost	0%	5%	0%	0%	0%	0%
User friendliness issues	5%	0%	6%	0%	11%	17%
Availability of data	26%	16%	22%	12%	26%	22%
Other reasons	5%	0%	0%	6%	0%	0%

Appendix D Review of the Dutch flood managers' survey

D1 Introduction

A total of eight people completed the survey aimed at flood managers in the Netherlands. These people are all involved in the development of tools and instruments, information and knowledge which could be used or already is used for the development of flood emergency management plans. They all answered "yes" to the question "Do you currently produce information actually used for flood event management planning?" Five responders are employed at a research institute, and three work for the Dutch Ministry of Traffic and Water Management.

In addition, two questions were added to the survey aimed at people involved in the development of flood emergency management plans. These additional questions are related to the current use of tools and instruments for plan development. This survey was send out to people involved in the Dutch Safety regions and included people working for the Water Boards. As well as being a partner within the Safety Regions, the Water Boards are partly responsible for the provision of information used for flood emergency management planning. Forty-five responders participated in this survey.

D2 Tools, methods and guidelines currently used the Netherlands

The responders involved in the development of tools and instruments were asked which methods and instruments they currently use or thought to be (potentially) useful for the development of flood event management plans. The results are shown in Table D1.

The responders involved in the development of tools and instruments were asked which methods and instruments they currently use or thought to be potentially useful for the development of flood event management plans. The results are shown in Table D2.

Table D1 Awareness and use of information for event planning in the Netherlands

Tools, methods or guidelines	Not aware (%)	Aware of tool (%)	Tool used to assist with plans (%)
Potential injuries and loss of life	0.0%	57.6%	42.4%
Flood extent	3.0%	24.2%	72.7%
Evacuation time	6.1%	48.5%	45.5%
Flood warning lead times	9.1%	24.2%	66.7%
Flood depths, velocities and flow routes	15.2%	33.3%	51.5%
Optimal evacuation routes	18.2%	51.5%	30.3%
Effect of implementation of measures (temporal levees, sand bags)	18.2%	42.4%	39.4%
Damage to critical infrastructure	21.2%	48.5%	30.3%
Available of resources	21.2%	48.5%	30.3%
Hazards triggered by floods	24.2%	57.6%	18.2%
Optimisation of the location of shelters	27.3%	57.6%	15.2%
Accessibility of inundated roads	27.3%	42.4%	30.3%
Effects of improvements in flood warning on the risk to people	30.3%	36.4%	33.3%
Potential damage maps	33.3%	48.5%	18.2%
Probability of buildings collapsing	42.4%	48.5%	9.1%

Methods for the assessment of loss of life and damage are thought to be used by the developers of the methods in the planning stage. When compared to the information actually used by the planners, shown in TableD1 it is seen that this is true for information on loss of life, but that information on potential damage are actually not being used extensively. Most of the methods are thought to be useful for the development of plans.

The following (type of) tools were mentioned by developers as potentially useful (existing or to be developed) although not listed in the Table D1

- Overview of flood simulations, including animation of flooding
- Data and GIS tools: (on land use, schools, hospitals, day-care for children, aid services, heights of the area)
- Instruments to determine the sensitivity of levees and their resilience to different scenarios. On-line determination of the damage to coastal defences using expected water heights and wave data
- Decision support tool for evaluation of different evacuation strategies

The flood event planners were asked which information they are aware of or actually use for the development of their plans. Thirty-three people responded to the question. The results are presented in Table D2. It should be noted that the question differs from the question stated in the English and French survey where the responders were asked which methods they are aware of.

It can be seen that information resulting from flood simulation models, such as flood extent, water depth and velocities are applied for the development of the plans. Recently more attention is given to research on casualties and evacuation. This information is used for the plans, but to a lesser extent then the flood simulation results.

In addition the responders were asked which tools, methods or guidelines they currently use for the development of their plans. The majority of the respondents (92.3%) declared that their organizations makes use of instruments (methods, guidelines, advice, software) for making Flood event plans. The types of tools used are:

- Guidelines and format; Inspection frameworks, Legal frameworks, scripts, national communication strategy;
- Flood simulation software;
- Traffic and evacuation simulation software;
- Action plans.

The responders mentioning some kind of format or guideline were numerous, although no consistency was seen in the named formats. Several responders mentioned a personal format or a format developed within the region. For example responders to the survey stated that:

"*We use a compilation of several methods and guidelines*"
"*We use a format developed in cooperation*"

Table D2 Awareness and use of information for event planning in the Netherlands

	Not aware	Aware of	Used in plans	Aware of and used in plans
Potential injuries and loss of life	0.0	57.6	42.4	100.0
Flood extent	3.0	24.2	72.7	97.0
Evacuation time	6.1	48.5	45.5	93.9
Flood warning lead times	9.1	24.2	66.7	90.9
Flood depths, velocities and flow routes	15.2	33.3	51.5	84.8
Optimal evacuation routes	18.2	51.5	30.3	81.8
Effect of implementation of measures (temporal levees, sand bags)	18.2	42.4	39.4	81.8
Damage to critical infrastructure	21.2	48.5	30.3	78.8
Available of resources	21.2	48.5	30.3	78.8
Hazards triggered by floods	24.2	57.6	18.2	75.8
Optimisation of the location of shelters	27.3	57.6	15.2	72.7
Accessibility of inundated roads	27.3	42.4	30.3	72.7
Effects of improvements in flood warning on the risk to people	30.3	36.4	33.3	69.7
Potential damage maps	33.3	48.5	18.2	66.7
Probability of buildings collapsing	42.4	48.5	9.1	57.6

It is seen that information resulting from flood simulation models, such as flood extent, water depth and velocities are applied for the development of the plans. Recently more attention is given to research on casualties and evacuation. This information is used for the plans, but to a lesser extent then the flood simulation results.

In addition the responders were asked which tools, methods or guidelines they currently use for the development of their plans. The majority of the respondents (92.3%) declared that their organizations makes use of instruments (methods, guidelines, advice, software) for making Flood event plans. The types of tools used are:

- Guidelines and format; Inspection frameworks, Legal frameworks, scripts, national communication strategy
- Flood simulation software
- Traffic and evacuation simulation software
- Action plans

The responders mentioning some kind of format or guideline were numerous, although no consistency was seen in the named formats. Several responders mentioned a personal format or a format developed within the region.

We use a compilation of several methods and guidelines
We use a format developed in cooperation

Required development of tools

The developers were asked if there were any tools or methods they would like to see developed for the assistance of flood event planning.

- Evaluation and improvement of event plans
- A tool providing an overview of measures and their effectiveness
- Flood defences

An equal question was given to the event planners. Of the responders, 61.5% would like some other instrument (existing or to be developed) to be available for Flood event planning. Types of instruments mentioned are:

- *Guidelines and standardization*. There is a need for more standardization of the Dutch flood event plans. This should result in making the plan uniform and simplifying them. This need corresponds to the observed diversity in formats and guidelines which are currently used.

  'In the TMO period, several regions have been active with plan construction. I missed a framework for setting up this plan, the do's and don'ts and more tips and tricks (region Noord-Holland-Noord). This results in many beautiful plans that cost a lot of time to construct, but that probably miss a solid general basis.'

- *Flood simulation and prediction*. Although the flood simulation and prediction methods are quite advanced, there is still a need for further development. This is especially seen for coastal flooding where there is a need to increase the accuracy of prediction time.
- *Evacuation simulation*
- *Training through serious gaming*
- *Information exchange.* Generally improving presentation. Specifically for different types of data; database development for resources, maps for Decision support.
- *General improvement of the user-friendliness of systems*

One person mentioned that: *there is enough room for improvement of the existing tools*

Obstacles to the use of tools, methods and guidelines relevant to emergency planning in the Netherlands

When looking into the reasons why information and methods are not being used (as assumed by the developers of the tools and methods), the main reasons given are: unaware of method and availability of data. The results are summarized in Table D3.

Table D3 Response to the usage of tools used for flood event planning

Current usage of tools to inform emergency flood plans (% of responders)	Methods to assess flood hazard from				Potential injuries and loss of life	Accessibility of inundated roads to vehicles
	Fluvial	Coastal	Dams	Other sources		
Currently used	62.5%	62.5%	-	-	50.0%	0.0%
Reasons given if not currently used						
Used, but not enough	25.0%	25.0%	-	-	12.5%	25.0%
Not relevant to plans	0.0%	0.0%	-	-	0.0%	0.0%
Unaware of method	12.5%	12.5%	-	-	25.0%	25.0%
Cost	0.0%	0.0%	-	-	0.0%	0.0%
User friendliness issues	0.0%	0.0%	-	-	0.0%	0.0%
Availability of data	0.0%	0.0%	-	-	12.5%	50.0%
Other reasons	0.0%	0.0%	-	-	0.0%	0.0%

Current usage of tools to inform emergency flood plans (% of responders)	Optimal evacuation route(s) from inundated areas	Effects of improvements in the dissemination of flood warnings on the risk to people	Potential damage to critical infrastructure	Optimising the locations of shelters with respect to floods	Assessment of other hazards triggered by flooding	Probability of buildings collapsing during floods
Currently used	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Reasons given if not currently used						
Used, but not enough	25.0%	62.5%	25.0%	25.0%	25.0%	25.0%
Not relevant to plans	0.0%	0.0%	0.0%	0.0%	0.0%	12.5%
Unaware of method	0.0%	37.5%	37.5%	50%	37.5%	37.5%
Cost	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
User friendliness issues	0.0%	0.0%	0.0%	12.5%	0.0%	0.0%
Availability of data	37.5%	0.0%	25.0%	0.0%	25.0%	12.5%
Other reasons	12.5%	0.0%	12.5%	12.5%	12.5%	12.5%

Developer's survey

Are their other methods and instruments not mentioned in the previous list of which you think they could be of use for the development of flood event plans?

GIS tools
- "Data en GIS tools, e.g. land use data, data with locations of schools, day-care centres, hospitals, emergency services, ground levels

Flood patterns
- LIZARD, a tool which shows all flooding patterns for the Netherlands
- The velocity with which the water rises and spreads

Evacuation
- Decision support tool in relation to evacuation strategy based on threatened area, behaviour people, number of people threatened, e.g. EvacuAid

Flood defences
- Instruments which determine the sensitivity (strength) for different water scenarios. The current national evaluation of flood defences only assesses one scenario, while in reality a number of scenarios are likely to occur.

Are there any other tools, methods or guidance that you would like to see developed that could be used by to develop flood emergency plans?

Measures
- Tools which provide an overview of measures and their effectiveness

Evaluation and improvement of event plans
- Tools which give insight into the effectiveness of flood event plans on casualty risk
- Evaluation instrument for training and exercise of event plans. Objective appraisal along a learning curve

Flood defences
- On-line determination of damage to coastal defences using expected sea water levels and wave information

Other comments
- Their is still enough which can be done on the mentioned instruments

- I think that for most of these methods not enough is known for them to be really useful for event planning e.g. chain effects, we know little of the release of toxic substance

- I also think that a good estimation is needed of rescue possibilities. Is there enough resources available to rescue everyone within a certain time, or are additional measures necessary

Planners survey

Please list the names of the tools, methods or guidance that you currently use that are of assistance to emergency plans

Guidelines and formats
- Guidelines
- Inspection requirements

- Several laws and acts (2x)
- Evaluation frameworks
- Guideline for preparation of event plan (general plan)
- National communication strategy
- For the development of a municipality event plan formats exist
- Personal format (2x)
- Model ‘calamity care’ from the water board union
- Format developed in cooperation
- Inter provincial evaluation framework for water board calamity plans
- TMO documentation and earlier instruments such as the LMR (leidraad maatramp operationele prestatie)
- We use for so far available, standard formats and available documents such as the national coordination plan
- A compilation of several methods and guidelines
- Format for evacuation

Flood simulation model (results)
- Flood simulations
- DSS for calculating flood scenarios
- Software of flood scenarios which shows the flood patterns in time
- Flooding atlas

Evacuation and traffic modelling
- Information on evacuation possibilities resulting form traffic modelling
- Evacuation calculator (2x)
- The HIS (High water Information System containing evacuation calculator and damage and casualties module)

Action plans
- Action plan

What needs do you have for (existing) instruments which can contribute to the flood event planning?

Guidelines e.g.:
- Automated action plan
- Format which encompasses earlier mentioned criteria and tips resulting in uniform event plans.
- Revision of existing formats resulting in simpler plans
- Uniformity of plans within the Netherlands. Even if there are standards available (for the general event plans), plans still differ considerably. This is due to the fact that we all think that our region is unique which justifies for deviation of the known procedures and phasing.

Flood simulation and prediction
- Instruments which contribute to improved flood scenario information
- For a coastal flooding it is of great importance to gain information on probability of failure of defences earlier in the event. Therefore more accurate predictions need to be performed

Training
- Improved training methods, e.g. serious gaming,

Information sharing
- In general: improved presentation and communication of information

- Resources: database containing both the organisations which are involved as well as the people and means (available capacity) which are available for evacuation and rescue and the location of the resources
- Informing: Maps to inform decision makers maps (for DSS) on e.g. people, traffic, businesses, infrastructure

User friendliness
- User-friendly information systems

Evacuation
- Dynamic model for evacuation with which different options can be evaluated fast
- Need for an instrument to be used during an actual event to be able to choose the correct measures for the situation

General comments
- More need for regional instruments
- In due time yes, but now the emphasis is on the fundamental planning

CRUE
FLOODING ERA-NET

Integrate, Consolidate and Disseminate European Flood Risk Management Research

Research supported by the 2nd ERA-NET CRUE Funding Initiative for Research in Flood Risk Management







Flood resilient communities – managing the consequences of flooding

ANNEX C TO TO THE FIM FRAME FINAL REPORT

CRUE Research Report No 3: Flood Incident Management – A FRAMEwork for improvement – FIM FRAME

WP4 Case studies: England, France and the Netherlands

Prepared by the Joint Project Consortium consisting of

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Project partner #4,
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Project Contract No: ERAC-CT-2004-515742
Project Website: www.crue-eranet.net

DISCLAIMER

Flood Incident Management – A FRAMEwork for improvement
CRUE Research Report No 3: Case studies: England, France and the Netherland

This report was prepared with the support of the CRUE Funding Initiative on Flood Risk Management Research. While reasonable care has been taken in preparing this publication to ensure that information is appropriate and valid it have to be considered that the views, conclusions and recommendations expressed herein are those of the authors and most not necessarily endorse the views of the CRUE ERA-NET or the respective Funding bodies involved.

The intent of the research reports is to provide relevant information and to stimulate discussion of those having an interest in flood risk management. The results and conclusions of all reports produced under the **Second CRUE Funding Initiative on Flood Resilience** are made available to policy-makers and stakeholders at all levels, research funding bodies, universities, industries, practitioners, and the general public by way of the CRUE website (http://www.crue-eranet.net).

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Flood resilient communities – managing the consequences of flooding

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME
Case studies: England, France and the Netherlands

CRUE Research Report No 3

Prepared by

Project partner #1, HR Wallingford, UK

Project partner #2, Deltares, The Netherlands Name of Research unit

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Project partner #4, University Montpellier III, France

CRUE Funding Initiative on FRM

John Goudie
ERA-NET CRUE Co-ordinator

Contents

1 Introduction

1.1 Background to the research

This report has been produced as part of Work Package 4 (WP4) of the ERA NET CRUE research project entitled Flood Incident Management – A FRAMEwork for improvement (FIM FRAME).

FIM FRAME is a 24 month project research project. The project is funded by:

- The joint Department for Environment, Food and Rural Affairs (Defra)/Environment Agency Flood And Coastal Erosion Risk Management (FCERM) Research and Development Programme and
- The Ministère de l'Ecologie, de l'Energie, du Développement Durable et de la Mer, en charge des Technologies Vertes et des Négociations sur le Climat (MEEDDM).

The research is being undertaken in the UK, France and the Netherlands. The project partners are:

- HR Wallingford, UK – Project coordinator;
- Deltares, The Netherlands;
- Gestion des Sociétés, des Territoires et des Risques (GESTER), University of Montpellier III, France;
- Laboratoire Central des Ponts et Chaussées (LCPC), Nantes, France.

The objectives of the research can be summarised as follows:

- To assess the “effectiveness” of a sample of current flood emergency plans in the UK, The Netherlands and France and to assess methods by which the plans can be improved;
- To evaluate the current tools and technical systems that are used to inform flood emergency plans and the ability of these tools to support future flood event emergency planning with the main aim of reducing residual risk (i.e. primarily loss of life);
- To establish how currently available tools (e.g. guidelines, models) can be used to improve emergency management plans for floods and whether there are any gaps in the tools that are available;
- To provide a framework by which emergency planning for flood incidents can be improved that will be tested in a number of case studies.

The research has been carried out in six Work Packages (WPs) as follows:

- WP1 - Effectiveness and robustness of flood event management plans;
- WP2 - Comparison of currently available tools for the emergency planning of floods;
- WP3 - Development of framework to improve flood event management;
- WP4 - Case studies utilising the developed framework to improve emergency plans working together with emergency responders, emergency planners and other stakeholders;
- WP5 - Dissemination of the results;
- WP6 - Management and coordination.

The relationship between the six Work Packages is shown in Figure 1.1.

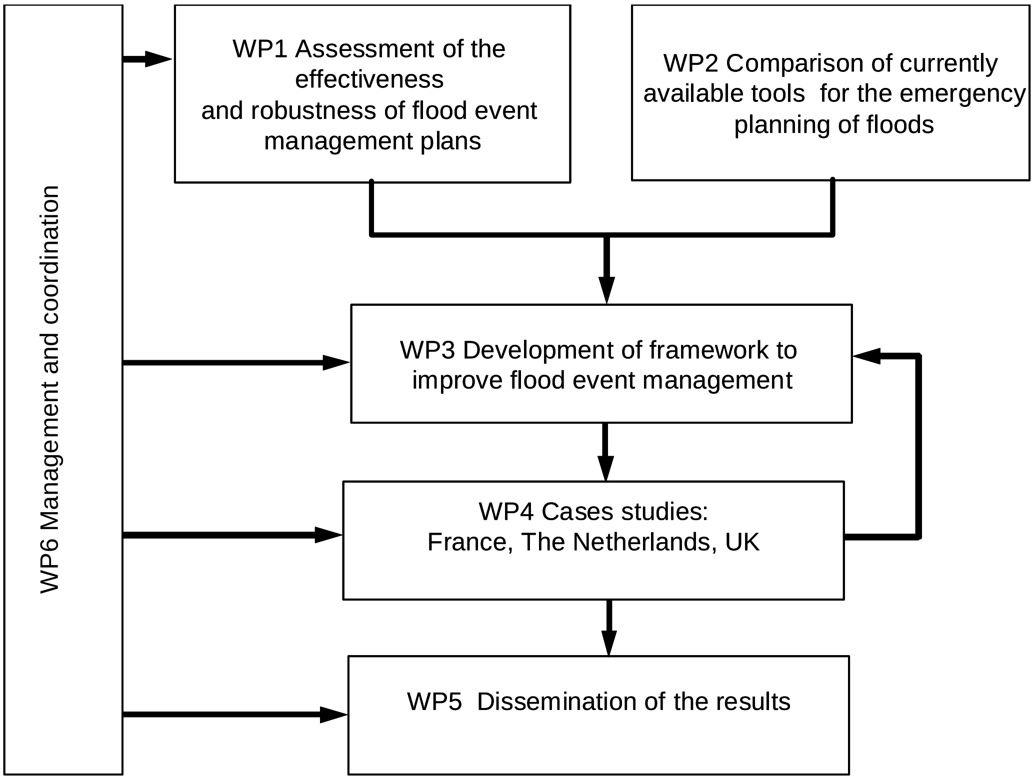


Figure 1.1 Relationships between the FIM FRAME Work Packages

1.2 Background to WP4

The main objective of the FIMFRAME project was to develop a framework or method to assess and enhance flood emergency plans. This framework will be part of practical guidance produces by the project which aims to provide an "integration" in the "good practices" for flood incident management. The project aims to achieve this objective through:

- To assess the effectiveness and robustness of current flood event management plans in England, Wales, the Netherlands and France;
- To evaluate the current tools that are used (or could be used) for flood event management planning and the ability of these tools to support the management planning and the management of future flood emergencies;
- To establish how currently available tools can be used to improve emergency management plans for floods and whether there are any gaps in the available tools
- To provide a framework by which flood incident management can be improved that will be tested in a case studies in France, The Netherlands and the UK.

As part of WP1 a number of emergency management plans for floods were assessed and their strengths and weaknesses described. WP2 presented tools that could help to fill the gaps in the plans. A survey highlighted the needs of flood managers in terms of tools to help them to enhance emergency plans for floods. A method called the FIMFRAME method has been developed as part of the research has been developed to help provide a tool to develop new and improve existing plans.

A number of case studies were carried out as part of WP4, the aim of these case studies was to test and apply the FIMFRAME method developed as part of the research. This report summarises the case studies and the feedback that was received from stakeholders relating to the implementation of the FIM FRAME method.

1.3 Structure of the WP4 report

The structure of this report is as follows:

- Chapter 1 details the context of the research and introduces WP4
- Chapter 2 gives an overview of the FIM FRAME method
- Chapter 3 presents the three case studies carried out in each country
- Chapter 4 provides details concerning how the method was applied in the case study areas
- Chapter 5 provides a summary of the feedback that was received from the stakeholders
- Chapter 7 details the conclusions
- Chapter 8 summarises the references used

2 Overview of the FIM FRAME method

2.1 Background

This chapter describes the FIM FRAME method for assessing and enhancing a generic flood emergency management plan. Building on the knowledge gained from the analysis of flood emergency plans in WP1, and the assessment of available tools for flood event managers (in WP2), a framework for the improvement of emergency plans based on the principles of the Business Elements Method was developed. This comprised a structured approach to the analysis and updating of such plans, and is illustrated in the following Figure 2.1.

The framework comprises three main components:

- Application of the metrics from WP1 to appraise an existing plan
- Use of an entity diagram, cross table and action table (taken from the Business Elements Method) to tackle the issues in existing or new plans
- Implementation of the improvements, possibly using tools to provide improved information.

This framework was designed to be:

- **Simple**, so that it can be applied by anyone without specific training.
- **Transportable**, so that that it can to be applied independently anywhere and by any flood emergency management team and to be adaptable to any kind of flooding (fluvial, flash flood, dike or dam failure…)
- **Generic**, to allow it to be adapted by the user for their specific purpose.

The framework is structured in three steps:

1. Appraise – applying the metrics to 'flag up' general issues
2. Tackle - structuring\de-structuring the process and identifying specific issues
3. Implement - taking actions to address the issues and updating the plan

These steps are shown in Figure 2.1. These steps do not need to be applied sequentially and the framework can be used by starting from any of them. For example, if no plan is in place the framework can be applied starting from step 2. In other cases, if some issues have already been identified e.g. as result of a post-emergency appraisal or an exercise, then the starting point can be set to be step 3. The framework can also be applied as a loop, re-appraising the plan after the last update.

In order to test and improve the framework, a workshop was held in Ipswich in July 2010, using the analysis of the Suffolk Multi-Agency Flood Plan (MAFP) carried out as part of WP1. The outcomes of this initial workshop and the views of the participants, came mainly from the Local Resilience Forum. Generally the framework was well-received, with most participants considering that they had gained a good understanding of it and that it could help them in their work. Certain aspects were considered to be somewhat academic, particularly the entity diagram, where further guidance and examples would be required to enable the general user to be able to produce one. This was seen as the most difficult area, whether one was starting at the Appraise or Tackle step, in terms of how detailed to make the entity diagram, and whether it was better to produce a high-level mapping initially.

The workshop materials were updated as a result of the Ipswich meeting, and this exercise was repeated with Local Resilence Forum (LRF) stakeholders from Sheffield in November 2010. This provides a direct comparison between the two sets of stakeholders. In general, the feedback was similar, indicating that the majority of participants had understood the framework and that it could provide useful insights into the development and update of flood emergency plans. Although positive, there were concerns over the lack of time and resources to apply the tackle stage, and that it might be better to simply apply the metrics to existing plans. However, more than one of the participants thought that the framework could be used as a training aid, particularly for new people involved in contributing to emergency plans.

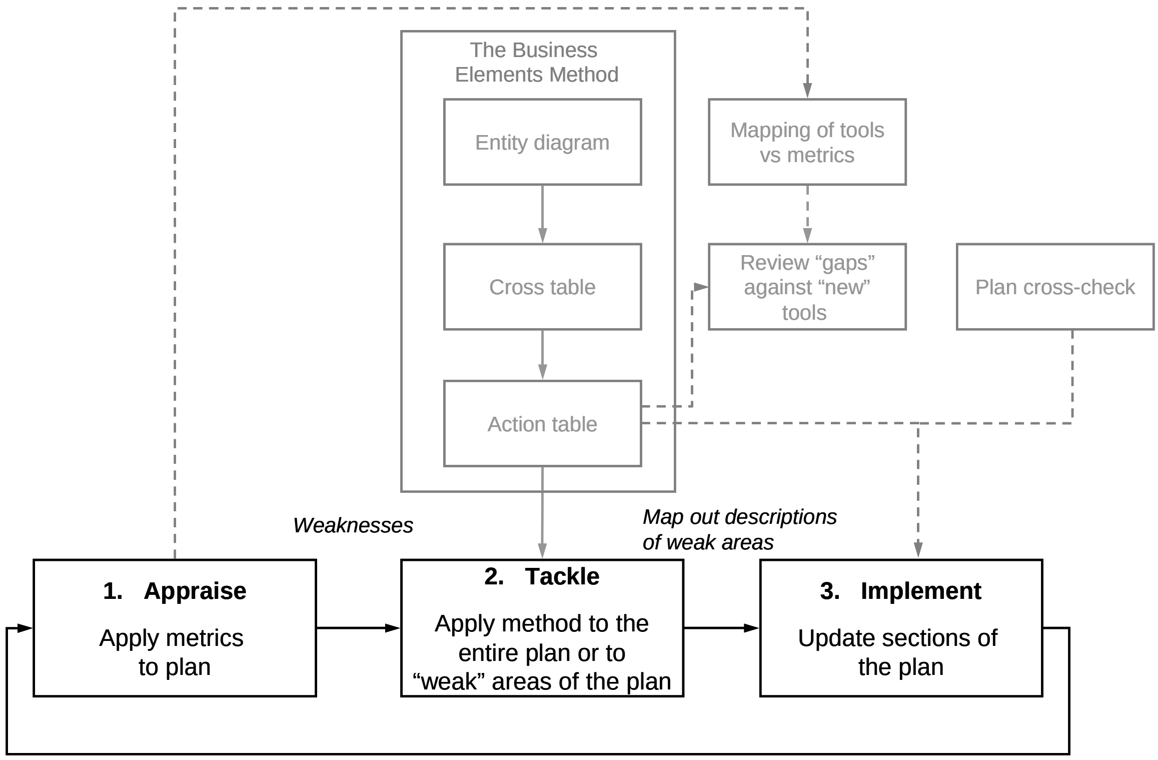


Figure 2.1 The emergency management analysis framework

The FIM FRAME method requires the application of the Business Elements Method, which is an approach for analysing any business process. The Business Elements Method is a tried and tested approach for analysing any process (or event); in this case the flood emergency plan. This method consists in examining the process in terms of five factors:

- Processes
- Roles and responsibilities
- Data and information
- Tools
- Audit

Considering these elements can help to produce a clearer picture of the process, and gain understanding on which are the interdependencies within the different parts that constitute the process. This can help in identifying, for example, possible issues or bottlenecks, and gaining a clear understanding of how to address these and how these can affect the process if they are not addressed.

The proposals given below for the ‘Tackle’ stage are our interpretation of how the method could be applied for emergency planning. This is because there is no rigid method, simply a recommended framework to use.

1. Appraise - Apply the metrics and flag up general issues or weaknesses

The appraisal of the plan consists in assessing the plan against the 22 metrics developed in WP1. This appraisal achieves an initial understanding on how the plan is likely to perform and what are the main weaknesses. The WP1 and FIM FRAME Guidance Document should be consulted for further details on the application of the metrics.

2. Tackle – “Structuring\de-structuring” the process and identifying specific issues

This step can be performed for the whole plan or only for particular aspects, for example those that obtained a low score in step 1. This step aims to go through specific processes (or plan components) and expand them into their constituent “items or entities”, each of these being analysed both individually and in combination with the other items they are linked to. This analysis is based on the application of the five principles of the Business Elements Method (processes, roles and responsibilities, data and information, tools and audit) that in this application have been adapted to comprise three subsequent steps:

(i) Describe the process - the Entity Diagram
(ii) Process\Responsibilities\Tools\Information - the Cross-table
(iii) Identify and tackle the issues – the Action table

To each of these steps there corresponds a specific outcome: the Entity Diagram, the Cross-table and the Action table; the latter will be used as the basis for the implementation and the update of the plan as part of step 3.

Step (i) Entity diagram

The first step consists in developing an entity diagram for the entire emergency process or for only a particular aspect (e.g. the plan activation or the identification of vulnerable people). The aim of this diagram is to include all the elements that constitute the emergency process and\or that have a role in the emergency planning or in the actual event. This diagram also aims to describe the relationship between such elements.

An ‘Entity Diagram’ is a diagram constituted by boxes and arrows. This diagram can be built to describe the entire process of formulating an emergency plan or focus on one particular aspect of the plan. The boxes contain specific ‘entities’. The ‘entities’ are the components that constitute the analysed aspect, which can be abstract entities (e.g. the warning, plan activation, the recovery, the evacuation) or physical entities (e.g. the police, the resources, the Strategic Coordination Group (SCG), the flood maps).

The arrows describe the relationship between such components. For each of the boxes, the following questions should be addressed:

- What does this entity do? (e.g. what is the process and who is responsible for the process)
- What does this entity provide? (e.g. what information is produced)
- Who does it inform? (e.g. who receives the information and who is responsible for passing this information)
- Who makes sure that this is done? (e.g. who audits the process)
- How this is done? (e.g. which tools are used\needed to produce the information or perform the process)

The answers to these questions might already be in a box in the diagram, and therefore an arrow can be drawn to connect the two boxes. Alternatively, another box should be added to identify the missing 'entity' and then connect the existing box with the new one. A typical entity diagram is shown in Figure 2.2.

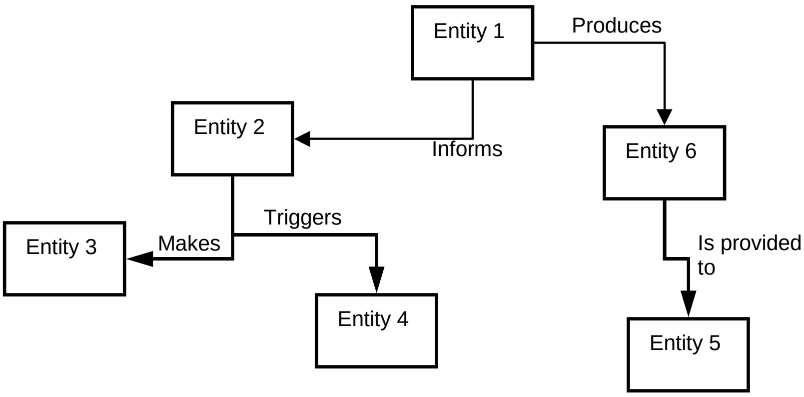


Figure 2.2 Example of an entity diagram

It should be noted that in developing the diagram, it is important to start from one specific topic (e.g. evacuation), which will constitute the first box. It is important at the start to challenge the attendees with the above questions, to help them to start producing the diagram.

Step (ii) - Cross-table - Process\Responsibilities\Tools\Information

The next step in the framework aims to consider each entity in the diagram. The outcome from step (ii) is a simple table containing all the entities in the first quadrant, the related roles and responsibilities in the second, the Information in the third and the tools in the fourth quadrant. This is shown in Figure 2.3.

1 Processes and procedures (what?)	**2 Roles\Responsibilities (who?)**
4 Tools (How?)	**3 Information (which data?)**

Figure 2.3 Structure of the cross table

Starting from one 'quadrant' of the cross table (e.g. Processes and procedures), the first question to ask will be:

Processes and procedures What does the entity do?

Once the process is described, the other part of the tables and the relative links should be completed by exploring:

FROM Processes and procedures TO Roles and responsibilities
Who is responsible for doing this? Who checks that this has been done?

FROM Processes and procedures TO Information
Which data or information are needed for doing this?

FROM Processes and procedures TO Tools

What tools are needed\used for doing this?

Once the links between Processes and procedures have been explored, the other quadrant of the tables should be analysed, starting from e.g. the Information quadrant:

FROM Information TO Roles&Responsibilities Who uses this data? Who is responsible for providing this information? Who audits that this information is provided \ disseminated?

FROM Information TO Tools How is this information produced? How is it communicated? Where\how is it stored?

FROM Tools TO Roles and responsibilities
Who owns the tools? Who has access to the tools?

This process is illustrated in Figure 2.4.

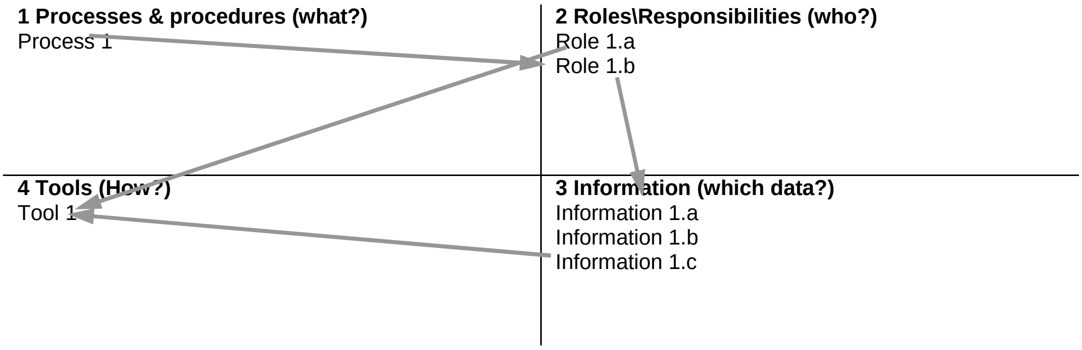


Figure 2.4 Filling in the cross table

This work should produce a better understanding of the elements of the process as well as of the links within the various elements. While constructing the Cross-table, certain issues can arise. These issues should be highlighted and will be discussed in detail in the next step.

Step (iii) – Action table

When identifying these links, certain issues can arise, for example:

- Identifying the links is not straightforward;
- Some links that should logically be in place do not exist in practice;
- Some information is not provided by any entity (e.g. neither tool nor person)
- Information is provided but not fed back to anyone

Once such an issue arises, this should be reported and described in the first column of the Action table. The blank action table is shown in Table 2.1Table 2.1.

Table 2.1 Action table – identifying 'Tackling actions'

Issues	Tackling actions					Implementation		
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed?	Who checks this is done? Audit	Priority	Resources	Timeline

For each of the identified issues, the user can analyse how to address them by going through the questions proposed by the table, and filling the columns accordingly:

How to address it? Defining a specific Action(s) that is (are) needed to tackle the issue.

Who should bring it forward? Identifying who should be responsible for taking forward each of the specified actions.

What information is needed? Listing possible information and sources of information

Is any tool needed? Discuss if any particular tool is needed to create the required information, who owns the tool and how this can be used. The list of tools gathered in the FIM-FRAME project – WP2 should be consulted to see if any are appropriate to the specific issue

Who checks this is done? Assigning a physical person who should be responsible to audit and check whether the action is brought forward as well as whether this is done correctly

Once the issue has been analysed, the step (iii) should be repeated for the other identified issues. The outcome of this process is the Action Table containing tangible actions that should be undertaken and audits that should be introduced into the process, as well as identifying responsibilities for these actions.

This simple analysis can provide a guide for exploring the process and spot possible issues, especially due to the links within different aspects that might not have been fully covered in an emergency plan for floods, and therefore might cause possible "bottlenecks" to the process.

Listing these items in a table might help to keep track of them, and this can be of help to check whether these have been addressed in the next review of the plan.

3. Implement - taking actions forward

This step should start from the issues and relative actions identified by the Action table. It can also start from specific issues identified elsewhere, e.g. directly through the appraisal of the metrics or by other means e.g. a post-event assessment. This step should include:

a. Plan cross-check, to identify specific parts of the plans that cover (or should cover) the issue.
b. Update the section of the plans, identifying detailed measures that should be taken to include the specific issue in the plan or to modify the plan so that the specific issue is covered.

c. Reviewing the action list and push forward the implementation plan.

Once the issue is described and the Tackling Actions identified in the Action Table, the Implementation part of the table needs to be filled in shown in Table 2.2. For each of the identified Actions, the following need to should be specified:

Priority What is the degree of importance of the particular actions (in terms of High, Medium, and Low) and\or what is the sequential order in the list of actions (whether this action needs to be done in 1st place, 2nd, 3rd...)

Resources What are the resources needed (in terms of time, people and\or money) for fulfilling this action and where\how these resources are secured

Timeline List of specific sub-actions with relative timelines

Table 2.2 'Implementation'

Issue	Tackling actions					Implementation		
	How to address it? Actions	Who should bring it forward? Responsibility	What informationon is needed?	Is any tool needed?	Who check this is done? Audit	Priority	Resources	Timeline

This step will translate the actions identified in the Action table into specific measures of implementation into the plans, including identifying a timeline for the implementation of the measures and resources that are needed for the implementations.

The whole table, supported by the Entity Diagram and the Cross-Table, will also provide strong and documented evidence of the reason for which the actions, and relative resources, are needed.

This can provide:

- A strong business case that will help to put the actions into practice by demonstrating the importance of securing resources
- A 'to do' list that can help prioritise the actions, if resources are limited, and tacke the most important issues first
- Evidence for demonstrating the importance of the identified actions to those involved in the planning process, helping to engage with them and gaining a collaborative attitude

Although the framework was considered useful for breaking the emergency planning process down into its constituent components, and that the various tools available would help in improving understanding, there were concerns over the time required to apply the framework to the majority of a plan. Several participants also thought the process was somewhat academic, particularly the construction of the entity diagram. Given that flooding is only one issue covered by the emergency planners in England and Wales, it was considered that there would be insufficient resources to apply the framework, except in special cases.

Building on this analysis, the framework has been produced with the objective of being refined and "ground truthed" through the collaboration of emergency planners. To be able to compare the results from the workshop, the same setup for the workshop was followed in the three countries. A few minor deviations were applied to account for the feedback of previous workshops and to account for the local and national contexts.

2.2 The workshops

The plans to which the framework was applied were chosen based on a number of criteria as follows:

- The scores that the plans received using the metrics that had been developed as part of WP2
- Willingness of local stakeholders to participate to the workshop
- The ability to compare plans between the three countries involved in the research

Table 2.3 provides a summary of the workshops held in the three countries. An initial workshop was held in July 2010 in Ipswich to test the FIM FRAME method and to allow adjustments to be made to it. Other workshops have been held between November 2010 and April 2011.

Table 2.3 Workshops held as part of the FIM FRAME project

Date	Location	Country	Plan	Kind of flood	Plan score	Selected metrics	Number of attendees
28 July 2010	**Ipswich**	**England**	**Multi-Agency Flood Plan (MAFP)**	**Fluvial and coastal floods**	**-**	**1- Details of previous floods 2- evacuation routes**	**8**
11 November 2010	**Sheffield**	**England**	**Sheffield MAFP**	**Urban flood and dam failure**	**2.14**	**- 1- Risk to vulnerable people 2- Media communication**	**14**
18 November 2010	Dordrecht	Netherlands	Regionaal Basisplan Overstromingen Zuid Holland Zuid, , specifiek Eiland van Dordrecht	Fluvial and storm surges flood (with dikes)	1.7	1- Evacuation 2- Loss of life	7
30 November 2010	Utrecht	Netherlands	Rampenbestrijdingsplan (dreiging) dijkdoorbraak Kromme Rijn dijkring 44'	Fluvial floods with dikes	2.5	1- Evacuation : communication to the public	3
8 December 2010	Piolenc	France	Plan Communal de Sauvegarde (PCS)	Flash flood and fluvial floods	1.4	1 - Flood warning 2 - Communication with the public	11
4 January 2011	**Tarascon**	**France**	**PCS**	**Fluvial floods with dikes**	**1.78**	**1 - Flood hazard map 2 - Warning system**	**11**
18 April 2011	**Sheffield**	**England**	**Sheffield MAFP**	**Urban flood and dam failure**	**2.14**	**1 - Evacuation routes 2 - Loss of life**	**6**

Note: Plans in bold relate directly to the case studies

3 Details of the case studies

3.1 Introduction

This chapter presents the main characteristics of the case studies. It gives details of the geographical features of the area, the context of flood emergency planning and the objectives and expected results of the case study.

3.2 Sheffield case study, England and Wales

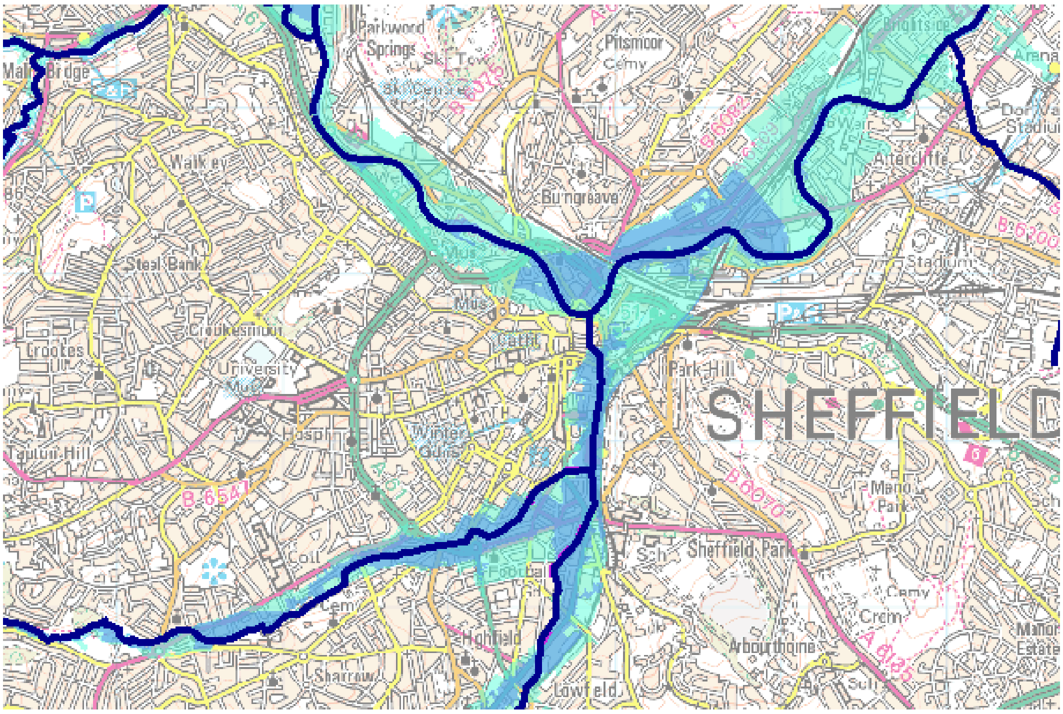
3.2.1 Background to the case study area

The city of Sheffield and its surrounding areas was chosen as the case studay area for England and Wales. Sheffield is located in South Yorkshire has a population of approximately 535,000.. Geographically, Sheffield is famous for being sited on seven hills, with the centre sitting within a natural amphitheatre at the confluence of five rivers: Don, Sheaf, Rivelin, Loxley and Porter.
There are a number of large dams located upstream of Sheffield many of which are over 150 years old. In 1864, 270 people were killed as the result of the collapse of the newly-built Dale Dyke Dam, upstream of Sheffield. The presence of such a great number of reservoirs poses a major risk to people due to a possible dam failure and subsequent flooding of the downstream areas.

As a result of its geographical location and topography, the city can experience flooding from a variety of sources. Although the rivers in the city are relatively small, heavy rainfall on the Pennine hills can result in fluvial flooding in certain areas. The fact that the city is surrounded by hills means that it is susceptible to pluvial flooding resulting from heavy rain, especially over the impervious areas. This was highlighted in summer 2007 when exceptional rainfall fell over the catchment on the 25 June, on what was already wet or saturated ground. Across England, June 2007 was one of the wettest months on record with some places experiencing double the normal monthly total. The city centre suffered extensive damage as the River Don overtopped its banks, with one fatality as a result of trying to cross a flooded road. Infrastructure was badly affected, with some businesses remaining closed until September. A major emergency operation was required, with some people being rescued by RAF helicopter.

Although the flood waters started to recede on the 26 June, a major incident was declared to the east of the city. Over 700 villagers from Catcliffe, near Rotherham, were evacuated after cracks appeared in the dam of Ulley Reservoir. Emergency services from across England pumped millions of litres of water from the reservoir to ease the pressure on the damaged dam, and the nearby M1 motorway was closed between junctions 32 and 36 as a precaution. For England and Wales, the summer 2007 floods, which occurred during June and July in various locations, was the largest flood event across the whole of Europe in terms of economic losses for the past decade.

With respect to the management of flood risk, the Environment Agency is the lead authority in terms of river and coastal flooding, and they provide publicly-available maps of such flooding so that homeowners can determine if they are at risk. An example of this flood map is shown in Figure 3.1, which shows the confluence of three rivers in the centre of the city. The dark blue areas are the 1% (annual probability) flood, and the light blue the extreme 0.1% probability flood. Maps for pluvial and dam break flooding are not available currently to the public.



(Source: Environment Agency, 2011)

Figure 3.1 Environment Agency flood map for Sheffield

The Emergency Planning Team of Sheffield City Council (SCC) is responsible for producing the Multi-Agency Flood Plan (MAFP), which is updated annually. This provides a framework for how the various responder organisations coordinate their activities during a flooding emergency, but does not replace the existing planning and operational arrangements in each organisation.

The MAFP is consistent with the South Yorkshire Strategic Framework Document, which outlines operating procedures for all aspects of major incident response and recovery in the region. A region-wide telecommunications plan for major incidents sets out the procedures between all the key agencies. The MAFP is also closely linked to a range of other flooding and emergency plans.

As part of the case study application, models were applied to simulate the impacts resulting from a dam failure, and how the resulting flood wave affects the downstream population in terms of loss of life. These models helped to demonstrate the use of enabling technology as part of the research.

3.2.2 Application of the FIM FRAME method to Sheffield – Step 1 - Appraise

Following a workshop in Ipswich in July 2010 and one in Sheffield in November 2010 to pilot the FIM FRAME method a final workshop was held on 18 April 2011 with the Local Resilience Forum in Sheffield to apply the final FIM FRAME method:

The objectives of this workshop were to:

- Apply the project metrics to the Sheffield Multi-Agency Flood Plan (MAFP)
- Use the FIM FRAME method to investigate the weaker areas of the plan, and identify possible improvements
- To provide a full test of the proposed FIM FRAME method to a MAFP

- To present the application of a Life Safety Model tool to a potential flood hazard in the Sheffield area.

The workshop comprised a series of group working sessions, to address each of the objectives, facilitated by HR Wallingford. Examples from the previous workshops were used to aid understanding of each step in the framework. The first activity was to apply the 22 metrics to the plan via a group discussion. The results are summarised in Table 3.1.

Table 3.1 Metric scores for the Sheffield MAFP

Metric	Level of detail			Score	Comments / Potential improvements
	Low	Medium	High		
Objectives, assumptions and target audience					
Aims and objectives of plan			●	3	
Target audience and updating of the plan			●	3	
Assumptions made by the plan		●		2	Provide more detail in the 'Scope' section
Organisation and responsibilities					
Actions, roles and responsibilities			●	3	
Recovery		●		2	
Training and exercises			●	3	
Plan activation		●		2	Include flow chart of activation actions
Communication					
Communication with other agencies		●		2	
Communication with the public		●		2	
Management of the media			●	3	Media management well signposted
Flood warning (if available)			●	3	Clear signposting to location of other maps
Relationship with complementary emergency plans detailed		●		2	
Evacuation					
Evacuation routes	●			1	Consider how to determine 'optimum' evacuation routes, and impact of flood on access
Shelters/Safe havens			●	3	Scored High because policy is not to include this information in MAFP
Flood hazard					
Flood hazard map		●		2	
Details of previous floods (if available)		●		2	

Metric	**Level of detail**			**Score**	**Comments / Potential improvements**
	Low	**Medium**	**High**		
Flood risk to receptors					
Flood risk to people	●			1	
Flood risk to vulnerable people (e.g. elderly or disabled)	●			1.5	Not realistic to provide up-to-date information as it changes daily
Flood risk to residential property		●		2	Residential and business properties need splitting out in the plan
Flood risk to businesses		●		2	“
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	●			1.5	
Potential for NaTech hazards at industrial facilities (if present)*	●			1	
	Average score			**2.14**	**An ‘Average’ plan**

The majority of the scores fell in the average or high category, with the plan overall obtaining an ‘average’ rating. The main weak areas were:

- Evacuation routes – no detail is provided, either on a map or in the text
- Detail is not provided on vulnerable people – there was a strong view that this information changes on a daily basis, and whilst the responders do receive updated information on a regular basis, it is not sensible to include this in the ‘static’ plan
- Critical infrastructure – although this is provided in a table, it is not included on a map
- NaTech hazards – in common with the majority of plans analysed to date, this information is not provided (or even known).

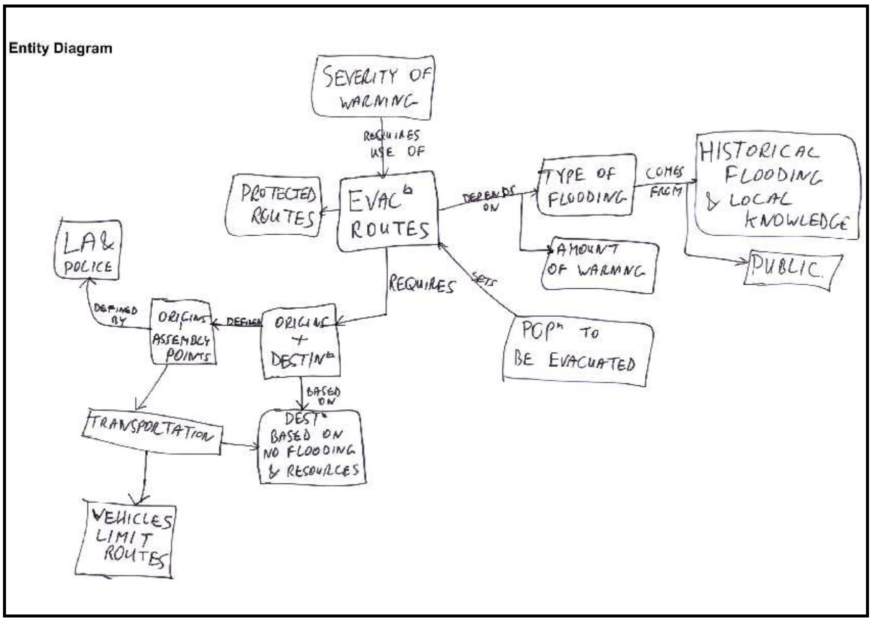
From this initial analysis it is clear that certain improvements could be made relatively easily, without the need for any new information or use of tools. Three possibilities are:

- Further explanation provided in the ‘Scope’ section on the assumptions made by the plan, such as what type of flood risks are considered
- A flowchart provided that summarises how the plan is activated and what roles the various responders take
- A diagram or flowchart is provided to show how the MAFP links in with other complementary plans, and what actions or events may require the use of each one.

With these simple changes, the average score would rise to 2.27, and the plan would then be assessed as ‘above average’.

3.2.3 *Case study application: Step 2 Tackle*

Based on this assessment, the group agreed to look at ‘Evacuation routes’ during the remainder of the workshop. The first part of the ‘Tackle’ phase was to build an Entity Diagram, as shown in Figure 3.2.



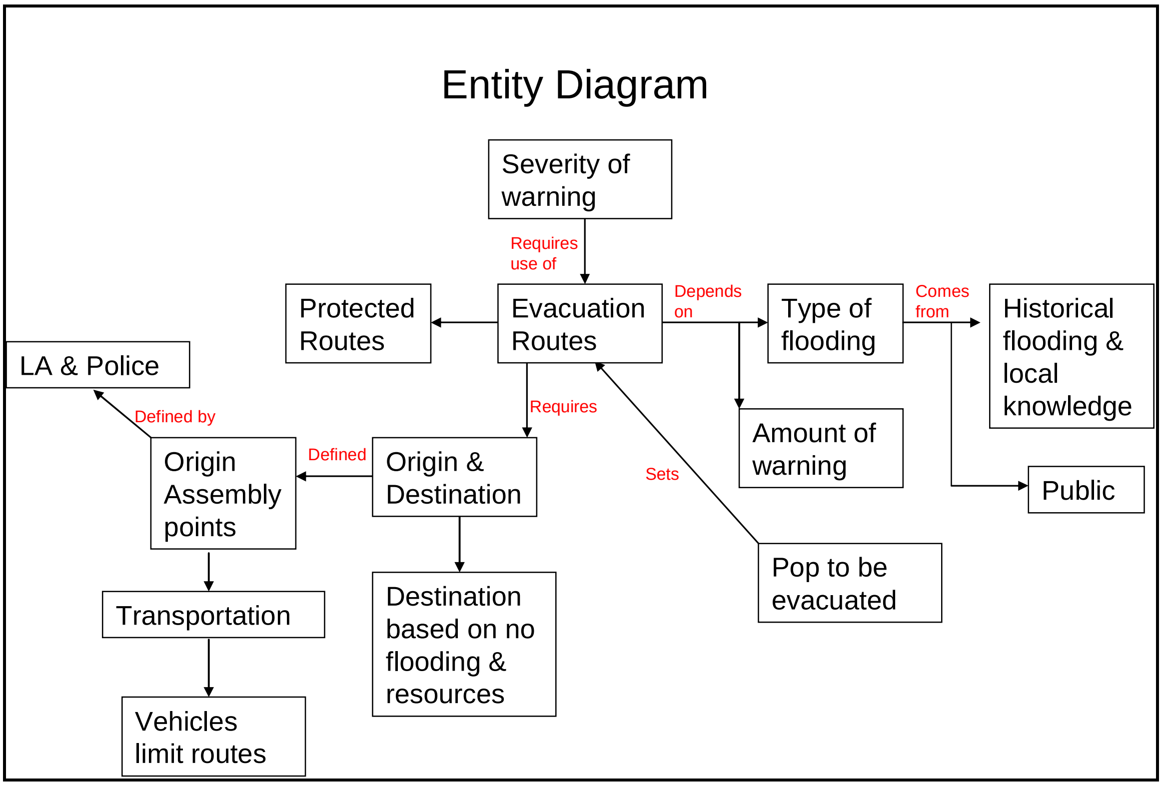


Figure 3.2 Entity diagram for 'Evacuation Routes'

Part 2 of the 'Tackle' phase was to fill in the Cross Table, which breaks the entities down into:

- Processes and procedures
- Roles and responsibilities
- Information
- Tools

From the entity diagram, the various processes and procedures were identified, and inserted in the first quadrant. These were then assessed on the basis of who was responsible for them, what information was required, and whether any tools or other technology was used or needed. The resultant table is presented in Figure 3.3.

During this analysis, the participants were asked to note possible difficulties in identifying the links between the various items in the table. Lack of clarity or missing links are dealt with as ‘red lights’ in the tackle process. Such items are to be noted in the first column of the Action Table. From the group discussions two key issues were identified: how were the public informed of the need to evacuate, and where should they be told to go (if at all). These points are summarised in Figure 3.4.

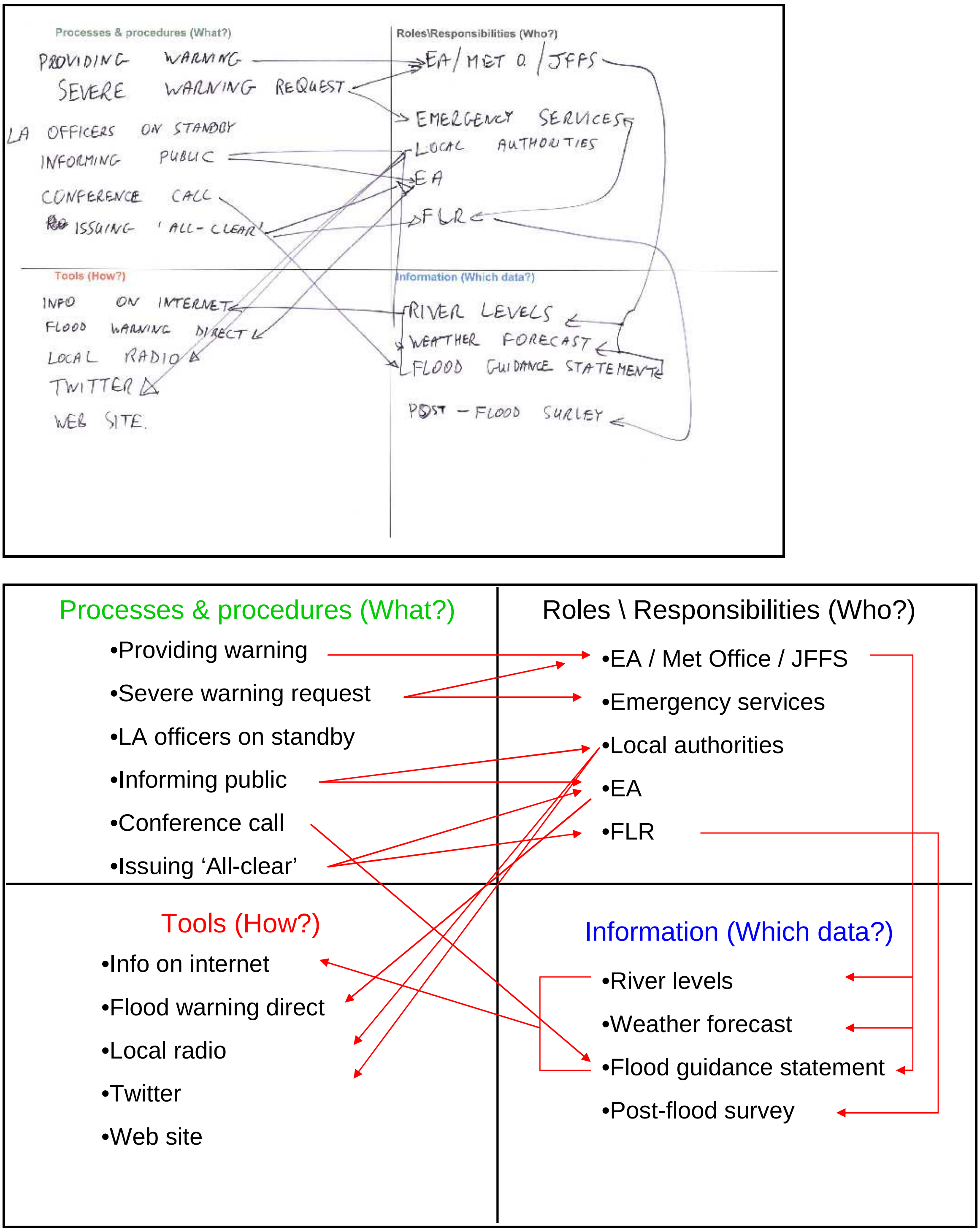
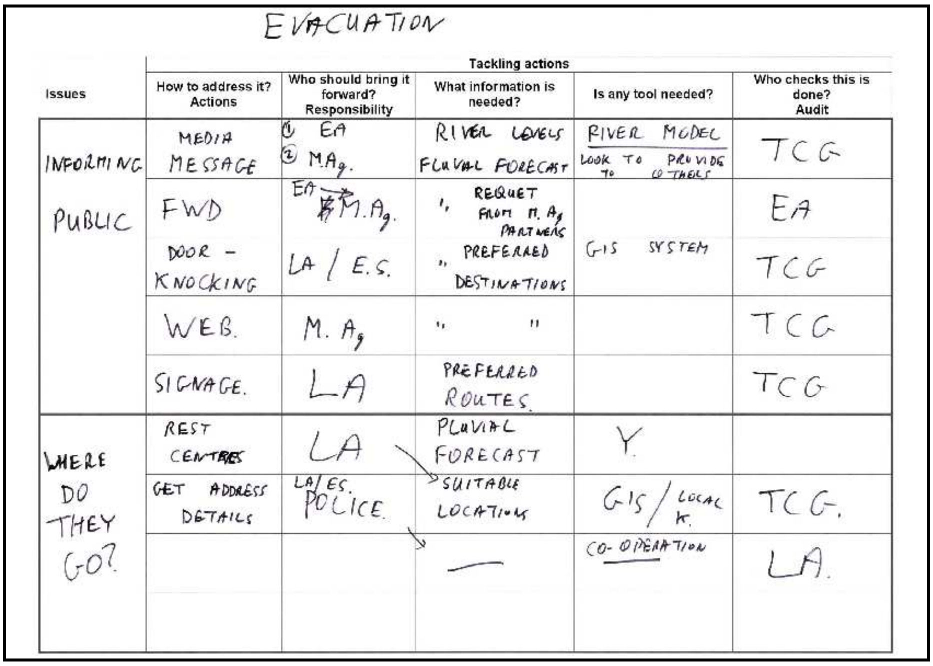


Figure 3.3 Cross Table for 'Evacuation Routes'



EVACUATION

Issues	Tackling actions				
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed?	Who checks this is done? Audit
INFORMING PUBLIC	MEDIA MESSAGE	① EA ② M.Ag.	RIVER LEVELS FLUVIAL FORECAST	RIVER MODEL LOOK TO PROVIDE TO CO-THERS	TCG
	FWD	EA → M.Ag.	" REQUEST FROM M.Ag PARTNERS		EA
	DOOR - KNOCKING	LA / E.S.	" PREFERRED DESTINATIONS	GIS SYSTEM	TCG
	WEB.	M. Ag	" "		TCG
	SIGNAGE.	LA	PREFERRED ROUTES		TCG
WHERE DO THEY GO?	REST CENTRES	LA	PLUVIAL FORECAST	Y	
	GET ADDRESS DETAILS	LA/ES. POLICE	SUITABLE LOCATIONS	GIS / LOCAL K.	TCG.
			—	CO-OPERATION	LA.

Evacuation

Issues	Tackling actions				
	How to address it? Actions	**Who should bring it forward? Responsibility**	**What information is needed?**	**Is any tool needed?**	**Who checks this is done? Audit**
Informing public	Media Message	EA M.Ag.	River levels Fluvial forecast	River model	TCG
	FWD	EA to M.Ag	Request from M.Ag partners		EA
	Door-knocking	LA / E.S.	Preferred Destinations	GIS System	TCG
	WEB	M.Ag	Preferred Destinations		TCG
	Signage	LA	Preferred Routes		TCG
Where do they go?	Rest centres	LA	Pluvial forecast	Y	
	Get address details	LA / Police	Suitable locations	GIS / Local knowledge	TCG
				Co-operation	LA

Figure 3.4 Action Table for 'evacuation routes'

3.2.4 Feedback

Following the conclusion of the group sessions and the presentation of the Life Safety Model described in the next section, the participants were asked to provide feedback on the framework and the outcomes of the overall project. This is given in Table 3.2.

Table 3.2 General feedback from the attendees on the framework and the project

<table>
<tr><th>Overview of the framework</th></tr>
<tr><td>The Generic Metrics sheet very useful for a self assessment of current plans with some tailoring particularly around flood risk to receptors. Difficult to obtain accurate information about vulnerable people – changes on a daily basis, particularly vulnerability due to medical needs. Flood risk to business is addressed through promotion of business continuity planning to businesses in the flood risk area.

Due to time restrictions, finding time to carry out follow ups such as entity diagrams on identified gaps or weaknesses would prove difficult. However the Action Table would probably be useful. It has to be remembered that emergency planning is not just about flooding and the metrics would be useful for other plans as well.</td></tr>
<tr><td>Metrics – very useful tool to find weaknesses in plans.

Framework as a whole is very time-consuming to complete. I doubt we would have time to complete whole framework, particularly for an annual review.

Not sure we would use the ‘Entity’ Diagram.</td></tr>
<tr><td>From EA re: Sheffield Plan

More information required to provide for plans, e.g.
flood warning lead times
split of properties between domestic and business
better fluvial modelling
Pluvial flood forecasting difficulties
Awareness of the Flood Warning system and how it can be used beyond initial flood warning.</td></tr>
<tr><td>Use of metrics is good for seeing where a plan fits, in terms of how comprehensive or complete.</td></tr>
<tr><td>The metrics are good for assessing a plan.

The most useful tool was the ‘Action Table’, although the ‘Cross Table’ was OK.

Did not really like the ‘Entity Diagram’; can’t see how we would use it, too time-consuming.</td></tr>
<tr><td>Metrics – good for evaluation of a plan. Some minor issues re: choice of phrases / words.

Life Safety Model – very good.
Needs to replay slower for better viewing / comprehension.
Implications for 3rd parties? (e.g. Media, dam owners)</td></tr>
<tr><td>Framework
Metrics very useful for self-assessment of plans – may need a bit of tweaking to refine definitions
Also must beware of writing a plan that fits the metrics – could result in over-detail / spurious accuracy
Entity Diagram
Difficult at first, but useful as analysis tool
Life Safety Model<ol start="2">
Information on worked example needs to be discussed by LRF as soon as possible.</td></tr>
</table>

This final set of feedback confirms what was found in the other workshops held in England & Wales. Although the participants could see that the framework did provide a set of useful tools and approaches for analysing and improving their emergency plans, there were concerns over the available resources (time and people) to be able to apply it fully. There was also a clear concern over some of the ‘academic’ aspects, such as the entity diagram, which takes time to understand. As the entity diagram is a key component of the Business Elements Method, the final form of the framework guidance will need to address how best to explain and recommend its use. The provision of several and varied examples will help in this regard. The use of the metrics, developed in WP1, remains a useful tool for the improvement of plans.

3.2.5 Application of tools to address gaps and issues

Background

As a result of the need to develop and test the framework in a couple of workshops, the final case study application for Sheffield was delayed until April 2011. This did not allow for the findings from the workshop to be used to inform the selection of various tools to assist in improving or filling the gaps identified in the plan. However, discussions had been held with the South Yorkshire LRF prior to and at the start of the FIM FRAME project. From these discussions, an interest was expressed in applying an evacuation and loss of life model to one of the reservoirs that lies upstream of the city. This was to look at issues such as adequacy of warning, speed of flooding, evacuation options and potential injuries and fatalities.

Description of case application

The issue of fatalities or injuries resulting from a flood is an emotive topic, particularly when predicting what may happen in the future in a particular area. The Environment Agency is keen to avoid unnecessary concern from the dissemination of such information, without providing the right context for the study. For these reasons, the case study will remain anonymous, and is simply a typical reservoir situated in the Pennines, with a small stream below it that ultimately runs into the city centre. In the specific case used here, though, there is a small town immediately downstream of the dam that would be at severe risk if the dam failed.

Tools applied

Although the main tool application in the case study was the Life Safety Model (LSM), various other tools were also used, both as input to LSM but also as a comparison with this model's results. A brief outline of each tool is given below.

TUFLOW

The main input for any loss of life technique is a representation of the particular flood hazard, which is usually produced by a hydrodynamic model. To represent the anticipated flood wave resulting from a failure of the dam, a two-dimensional model was used, based on the finite difference software TUFLOW. An existing model of the river was obtained from the Environment Agency and modified to include the dam break scenario.

TUFLOW is a computer program for simulating depth-averaged, two and one-dimensional free-surface flows such as occur from floods and tides. TUFLOW was originally developed for modelling two-dimensional (2D) flows, and stands for Two-dimensional Unsteady FLOW.

TUFLOW is specifically orientated towards establishing flow patterns in coastal waters, estuaries, rivers, floodplains and urban areas where the flow patterns are essentially 2D in nature and cannot or would be awkward to represent using a one dimensional (1D) network model.

Breach development

As the simulated flood is due to dam failure, a realistic representation of the event requires the modelling of breach initiation and growth. However, as stated in the FLOODsite website (2009), many gaps in knowledge, uncertainties and even contradictions remain when talking about breach prediction as much for the process leading to the breach as for the way to model it. The current degree of uncertainty in the prediction of breach initiation and formation processes is high in comparison to, say, the accuracy of modelling flow in a river. However, the accuracy of predicting breach initiation and breach growth through flood embankments, embankment dams and coastal dikes affects the accuracy of flood risk analysis and the degree to which flood risk management activities may be refined. In fact, the way in which a flood embankment might fail, or breach, directly affects the timing and volume of flood water that might be released. Consequently, breach initiation and growth processes have a significant role in determining subsequent flood impacts (FLOODsite website, 2009).

As the main purpose of the current study is not the breach modelling, a simplified approach was followed in the definition of the hydrograph of the water release from the dam: the literature available helps to assess the likely breach width, the failure time (i.e. the time from the first appearance of cracks to the final size of the breach) and the peak flow. These three parameters have been evaluated as a function of the depth and volume of the water above the breach, shown in Figure 3.5, the reservoir storage volume which is 2,450,240 m^3 and other parameters which are required for different equations available from the literature. These are given Table 3.3.

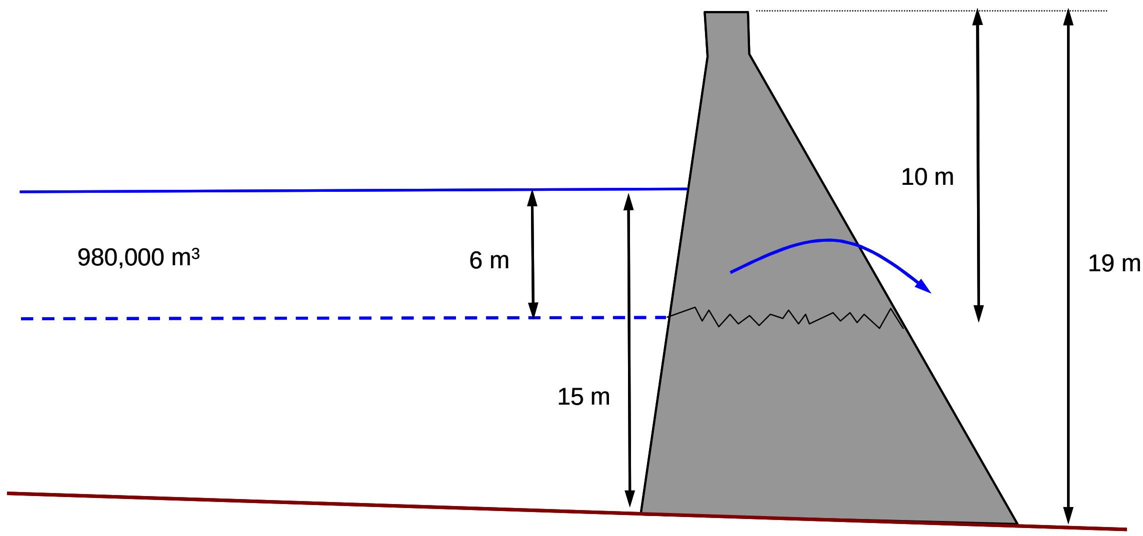


Figure 3.5 Schematic view of parameters that are important to dam break

Table 3.3 Summary of breach calculation outputs

Breach width equations	**Breach width (m)**
Bureau of Reclamation (1988)	18
Froehlich (1995)	23.078
Failure time equations	**Time of failure (hours)**
MacDonald and L.M (1984)	0.373
Von Thun and Gilette 1 (1990)	0.370
Von Thun and Gilette 2 (1990)	0.962
Froehlich (1995)	0.479
Bureau of Reclamation (1988)	0.254

A number of equations have been used to estimate the peak outflow due to the failure of the dam. The results varied between 126 m^3/s to 6230 m^3/s. This range is large and a reasonable estimate has to be selected to be used further in flow and life safety modelling.

Wahl (2004) presented a quantitative analysis of the uncertainty of various regression based methods for predicting embankment dam breach parameters and peak breach outflows. These included the ones that have been used for this case study. He concluded that the uncertainties of predictions of breach width, failure time, and peak outflow are large for all methods. Based upon his analysis, he found that the Froehlich peak flow equation has the least uncertainty which is about ±1/3 order of magnitude. Based upon that, the peak value estimated using the Froehlich equation (i.e. 328 m^3/s) has been used in this reservoir study.

To construct a flow hydrograph for this peak, the method recommended by the Risk Management for UK Reservoir Manual (2000) is used. This method estimated that the time to peak outflow would be 720 seconds and the total failure time would be about 6000 seconds. Assuming a triangular hydrograph shape, the following inflow hydrograph, shown in Figure 3.6, can be obtained.

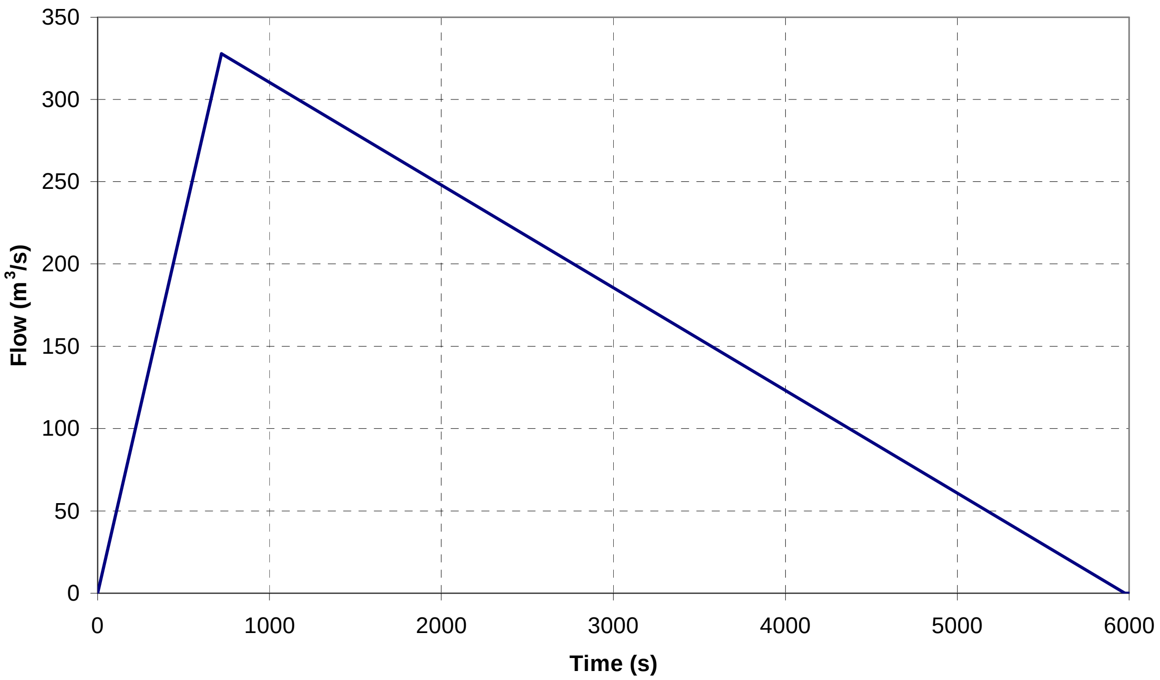


Figure 3.6 Hydrograph of the water discharge from the dam breach

This hydrograph was used then as a boundary condition for the Tuflow model. The time of the simulation was set up as three hours, whereas the water discharge from the collapsed dam lasts 1 hour 40 minutes (~ 6,000 seconds) with the flow peak occurring after 12 minutes (equivalent to 720 seconds).

Flood Risk to People

The 'Flood Risk to People' is a methodology to evaluate death or serious harm to people that occurs as a direct result of the flood either during or up to one week after the event. It also provides measures of annual average risk that can be used alongside annual average economic damage and other social and environmental criteria to improve flood risk management.

The model has been developed in England and Wales by the Department for the Environment, Food and Rural Affairs (Defra) and the Environment Agency. The Risks to People method considers the physical characteristics of the flood and the vulnerability of objects involved, to determine the overall flood risks to people. The method is based on three concepts:

- *Flood Hazard*, describes the flood conditions in which people are likely to be swept over or drown in a flood, and is a combination of flood depth, velocity and the presence of debris.
- *Area Vulnerability,* describes the characteristics of an area of the floodplain that affect the chance of being exposed to the flood hazard. People are more vulnerable in areas of low rise, single-storey buildings, campsites and open floodplain areas than in areas of two-storey or high-rise buildings that can provide "safe refuge" above the maximum flood level.
- *People Vulnerability,* describes the characteristics of the people affected by flooding and their ability to respond to ensure their own safety and that of their dependants during a flood.

These are combined for each zone of the floodplain in order to estimate the number of fatalities and serious injuries as a result of the flood.

The variables considered in the model, listed for each model parameter, are:

Flood hazard represent by:

- Depth of flood water (m)
- Velocity of flood water (m/s)
- Debris factor (score)

Area vulnerability represented by:

- Flood warning: including % of at risk properties covered by the flood warning system; percentage of warnings meeting the two-hour target; and % of people taking effective action (score)
- Speed of onset of a flood (score)
- Nature of area: multi-storey apartments; typical residential/commercial/industrial properties; bungalows, mobile homes, campsites, schools etc (score)

People Vulnerability represented by:

- Percentage of residents aged 75 years or over.
- Percentage of residents suffering from long term illness.

Life Safety Model (LSM)

The Risk to People method to assess the "loss of life" from flooding described in the previous section is based on empirical analyses of fatalities and injuries from historical events. Empirically based loss-of-life models tend to apply one mortality rate to an area and do not model each individual person. To improve the accuracy of loss of life estimates the Life Safety Model (LSM) links the fate of each person with the local characteristics of the floodwater (e.g. velocity and depth), and also allows people to interact dynamically with it.

In order to obtain the emergent behaviour of people during floods the LSM has been developed as an agent-based model. An agent-based model is a computational model that simulates the interactions of autonomous receptors with a view to assessing their effects on the system as a whole. The Life Safety Model was originally developed for dam break risk assessment for small communities in Canada and has a long and well-validated history. It has now, however, been piloted in the UK and it is currently under development in order to allow its use in a European context and for different flood hazards.

Its potential function will be to compare different emergency plans, and help planners to select the most appropriate evacuation strategies.

The LSM needs the following inputs:

- The location of individual properties, vehicles and people;
- Flood depths and velocities from a two dimensional hydraulic model;
- The road network and other evacuation pathways.

These input data are processed and then handed to the "Life Safety Simulator", which is the effective core of the LSM; the Life Safety Simulator requires two inputs (obtained from the previous input data):

An initial state of the world (which describes modelling receptors such as people, buildings, cars, roads). This is developed from census and property data sets;
Details of how the velocity and depth of the floodwater changes as the event progresses. This is taken from the results of two dimensional hydraulic modelling.

The outputs of the simulation are an estimation of loss of life as well as a dynamic, computer-generated visualisation of the results. The LSM models the "fate" of a set of receptors, which are described by their position at each time step through the simulation. Each receptor can have a set of properties that describes its normal location/condition during a week, such as travel times, school/work hours, and weekend activities. Other time-varying properties include the ability of the receptor to withstand the effect of the flood wave, and how it would react to the approaching wave, with and without a formal evacuation warning.

The model uses a generalised event logic to determine the location of each receptor, whether it is aware of the flood wave, whether it is trying to find a safe haven, what happens if it encounters the flood, and whether the object survives or not. A loss function related to each receptor (e.g. people, buildings, and vehicles) specifies the ability of a receptor to resist the impact from the flood wave, in terms of depth and velocity, and how these can change during an event. There can be instantaneous loss when an individual encounters fast-flowing water, or a group who have sought safety in a building can suffer cumulative loss if the building collapses or a slow deterioration in health if they are exposed to the flood water for a significant length of time, as a result of hunger or cold.

As a flood event evolves, the interaction of receptors with the flood wave will impact the ultimate loss of life. The timing of the event and the decisions made by individuals can determine whether or not they can escape the flood wave. As the flood progresses, escape routes can be eliminated by rising water, and with advancing time roads can become congested with evacuees.

An interesting aspect is that the LSM is unique in that it allows dynamic interaction between the receptors (e.g. people, vehicles and buildings) and the flood hazard. For this very reason, the LSM requires a significant amount of data including:

- The location of individual properties, vehicles and people;
- Flood depths and velocities from a two dimensional hydraulic model;
- Details of the road network and other pathways.

Base data for study area

A key dataset for the hydrodynamic model and LSM is the ground elevation. A Digital Terrain Model (DTM) was obtained from the Environment Agency. For the 'risk to people' methodologies it is necessary to specify the location of the population and buildings for area of interest:

Information about the population has been retrieved from the 2001 Census; a GIS was used to locate the different census areas, also to provide the total number of inhabitants for each of them.
Building location has been obtained from an Ordnance Survey map.

The total population considered in the simulation is 13,836 whilst the number of buildings is 7,420. It was been assumed that all the people are located inside the buildings, thus the population for each census area has been split equally between the buildings. Figure 3.7 displays the position of buildings, and the census areas marked with a different colour according to their inhabitants' density:

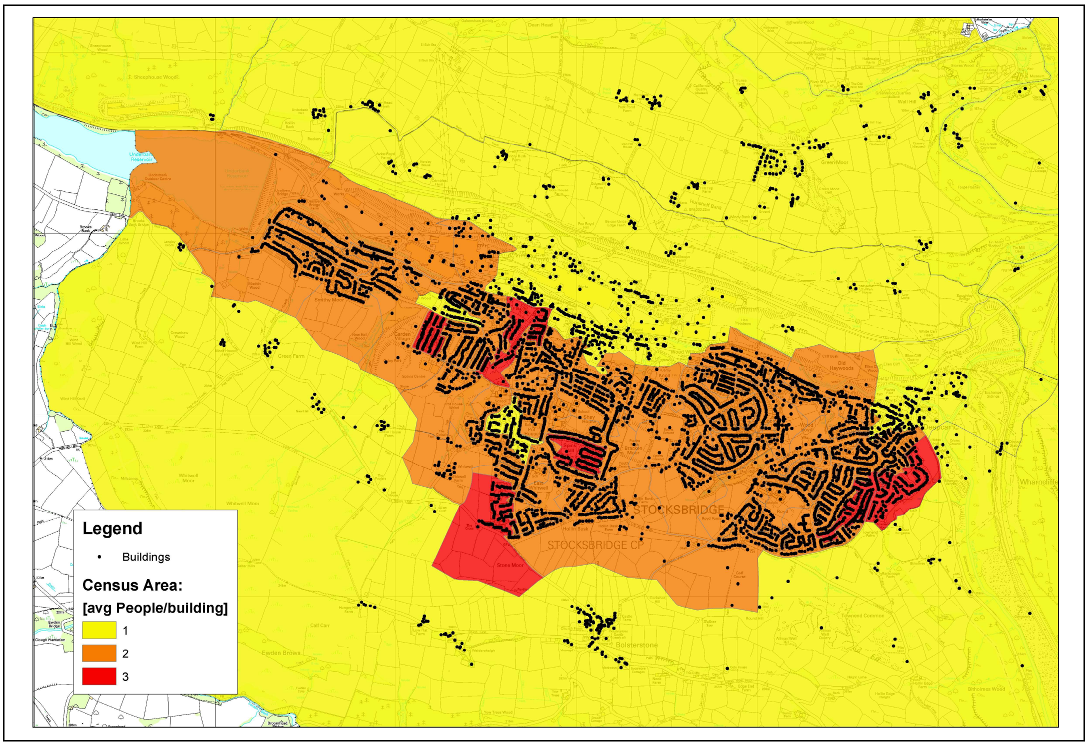


Figure 3.7 Buildings and census areas for the study area

Summary of results

(i) Flood hazard

From the hydrodynamic modelling it is possible to show the maximum depth and velocity of the flow; for simplicity the Figures 3.8 and 3.9 show only the initial stretch of the river below the dam.

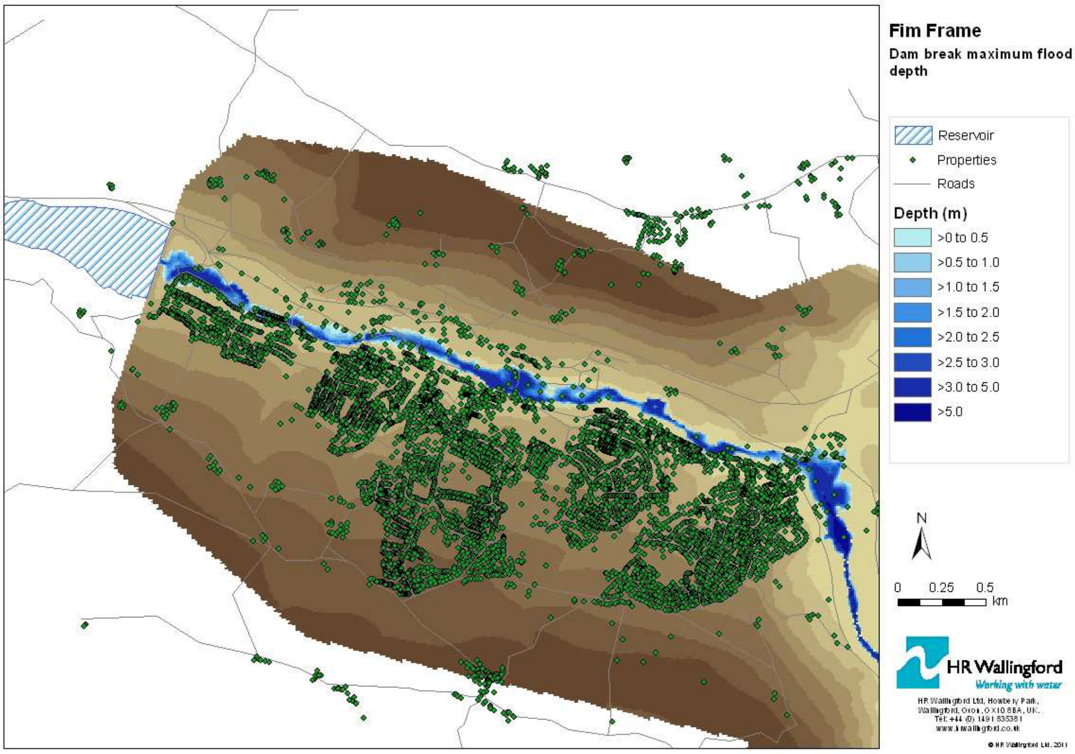


Figure 3.8 Maximum water depths

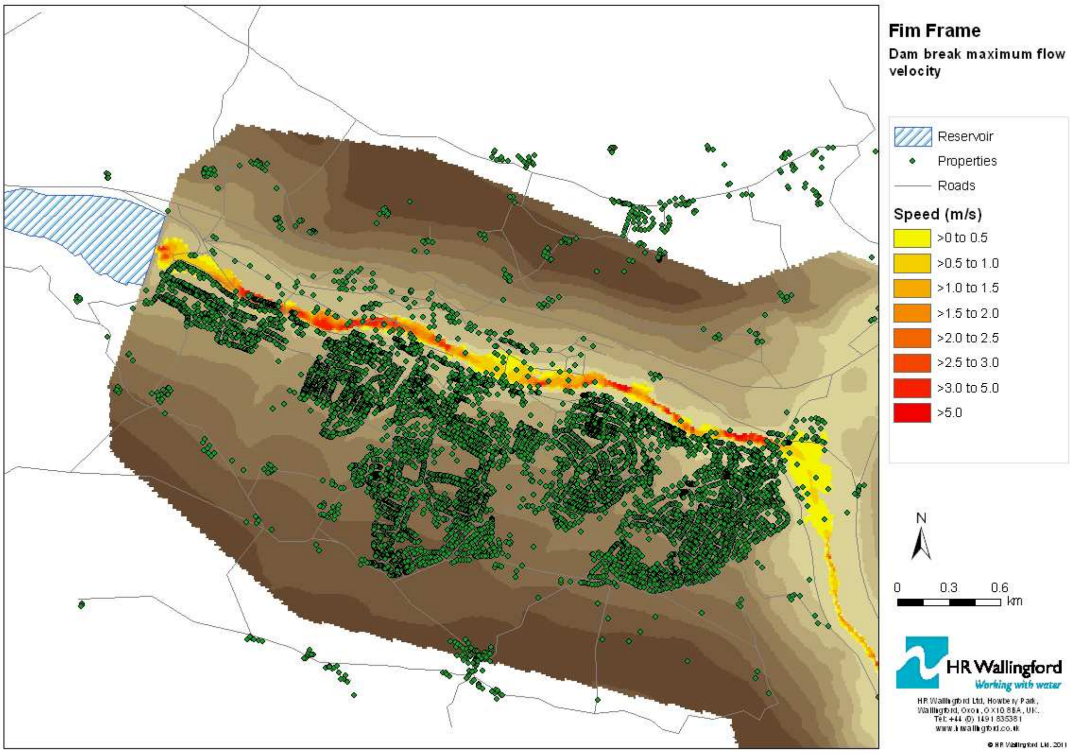


Figure 3.9 Maximum water velocities

It can be noted from Figures 3.8 and 3.9 that the maximum extent of the flooding and its characteristics:

- Given the topography of the area, which comprises a narrow and long valley, the flow is concentrated in the bottom of the valley.
- As a result of the topography, again, the water depths and velocities are very high, especially near the dam.

Another interesting aspect is the visualization of the flooding process from the moment in which the breach first occurs, considering a time-step of five minutes and taking into account the first 60 minutes.

Figure 3.10 shows the water propagation during the event. It is possible to locate the areas downstream the dam that are reached by the flood at different times. The flood wave appears to be very fast, covering a distance from the dam about 0.9 km after only 15 minutes, and 2 km after 30 minutes. Hence it could be highlighted the importance of this map with respect to flood protection and emergency planning, because it provides essential information regarding the different areas of the town reached by the flood wave at different times.

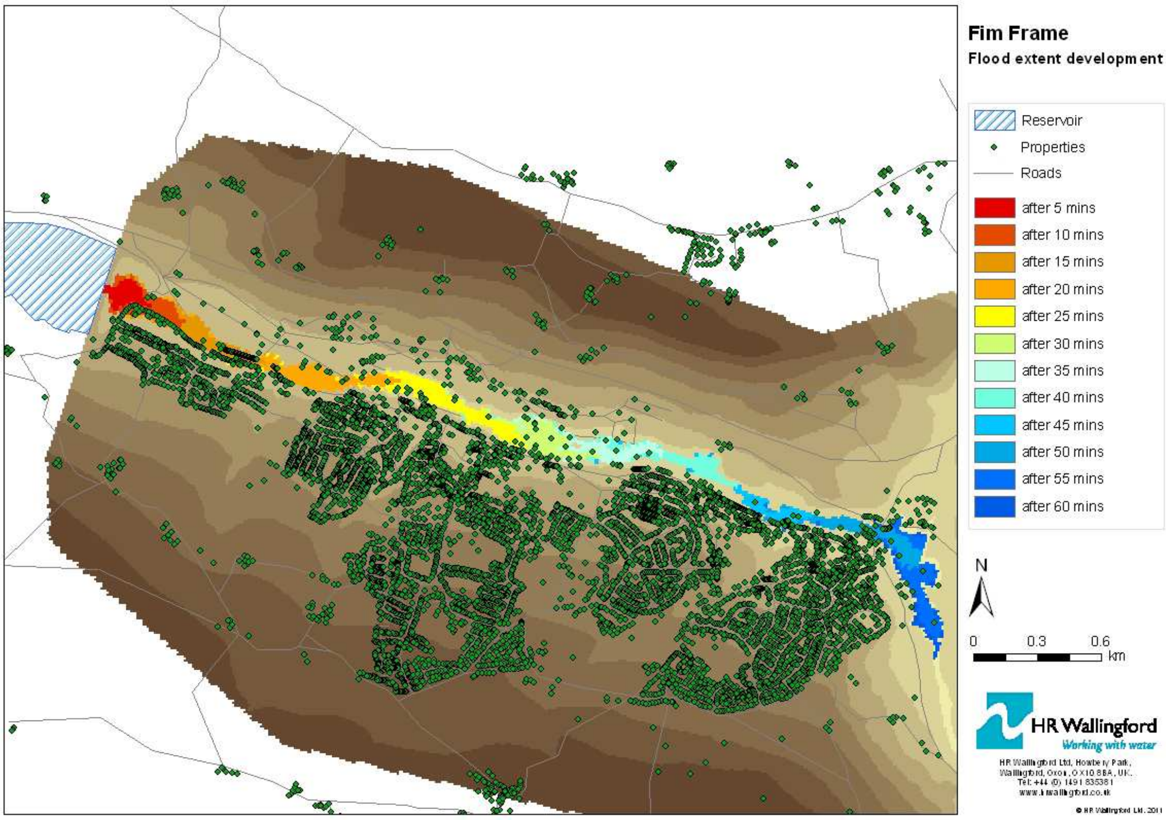


Figure 3.10 Flood extent development

Receptor impacts

The Flood Risk to People (FRP) and Life Safety Model (LSM) are among the best available currently for the purpose of loss of life estimation. The two models have a different framework and are based on different equations, but it is still possible to note the following similarities and differences:
The FRP takes into account the flood characteristics as their main input parameters, and return as output a fatality rate related to each different zone of the study area; therefore the number of fatalities can be

obtained by multiplying the number of people within each zone by its corresponding fatality rate, applying the following general equation:

$$Fatalities_{TOTAL} = \sum_{i=1}^{n} (fr_i A_i)$$

where:

$Fatalities_{TOTAL}$ is the total number of fatalities
n is the total number of homogeneous zones
A_i is the i^{th} homogeneous zone
fr_i is the fatality rate concerning the i-th homogeneous zone

The LSM is an agent-based model, which simulates the interactions of autonomous receptors with a view to assessing their effects on the system as a whole. The LSM can simulate the flood effects in a better level of detail, modelling each individual person during the event, and allowing them to mutually interact. Table 3.4 summarises the comparison between the models' results.

Table 3.4 Results of the comparison between the models.

		Flood Risk to People		Life Safety Model no warning		Life Safety Model with warning	
Population		13,836		13,836		13,836	
Deaths	Total	8.5	0.1%*	240 (153)**	1.73% (1.11%)	35 (35)**	0.25% (0.25%)
	Drowning	-	-	150	1.08%	35	0.25%
	Exhaustion	-	-	3	0.02%	0	0.00%
	Building collapse	-	-	87	0.63%	0	0.00%
	Vehicles swept away	-	-	0	0.00%	0	0.00%
Injuries		64.2	0.5%				

*percentage evaluated on the total population
**in brackets, the total deaths and percentage if building collapse is not considered.

The LSM has been run with and without a warning centre that issues a warning as the dam is breached. The main effect of the warning is to allow people to move away from the area with the highest velocities and depths, which has the added benefit in removing the deaths caused by collapsing buildings. So an evacuation policy of moving to higher ground, rather than sheltering in buildings, is the preferred option.

Potential use of tools for improvement of emergency plan

In this case study we have only considered the impact of a dam failure on the town immediately downstream: however, the flooding impacts would be felt downstream within the city of Sheffield and therefore the total impacts would be higher than presented here. There will therefore be a need to consider the emergency arrangements for the town, as well as the wider emergency measures within the city, and to consider similar impacts from other reservoirs.

The results from the application of LSM were presented at the LRF workshop, and the animation of the flood wave and the movement of the population provided a very clear representation of where fatalities occurred and where the population needed to move to escape the floodwaters. Two key conclusions were reached:

1. The provision of an adequate warning of a breach at the dam was vital, and means to transmit this warning to the rest of the town should e considered
2. The narrow form of the valley means that fatalities only occur in the riparian zone, so if people move uphill, perpendicular to the river, this will afford the greatest safety.

The LRF needs to consider whether dedicated uphill escape need defining, or whether general advice can be given for people to simply move away from the river once the warning siren is heard. This also needs to consider whether specific shelter locations need to be defined. Some form of permanent signage could be used to remind people that a flood risk exists and where they should move.

Beyond this simple analysis, the LSM could be used to further investigate different warning rates and locations, plus the designation of shelters. This last option is probably not realistic as the linear nature of the town means that a large number of shelters would be needed if people were to get to high ground as quickly as possible. It is probably better to define the major roads to be used to get right away from the area, where people can be advised on where to proceed to. The results from the analysis can be used to improve the mapping of flood hazard and the location of any businesses or infrastructure that would be affected by the dam failure. To summarise the tools applied helped with the following:

- Planning evacuation routes
- Determining shelter and safe haven locations
- Defining warning arrangements

Conclusions and recommendations

An analytical framework for application to flood emergency management plans has been developed, based on the principles of the Business Elements Method (BEM), and been trialled in three workshops in the England. Generally the framework has been well-received, particularly application of the metrics, with various aspects considered to be useful to the emergency management process. The entity diagram, which is a key component of the BEM, was seen to be somewhat academic and there was concern that emergency planners would not have the time or understanding to apply this as part of their normal work. These key findings will be addressed in the production of the final guidance, which forms one of the FIM FRAME project outputs. It will be important to provide sufficient assistance and examples of how to construct an entity diagram, and why it remains a useful part of the whole framework.

The Sheffield LRF was keen to look at the flood risks and consequences arising from a potential dam failure upstream of the city. Several linked tools have been applied to investigate this issue, and some important findings have been produced. To date, it has only been possible to discuss these with the LRF in general terms. However, a further national meeting will provide an opportunity to discuss the use of tools to inform the content of MAFPs, and the developing assessment of flood risks associated with the UK's dams. Again, there is the issue that emergency planners, who have to cover all risks to society, do not have the resources to make much use of tools as part of their planning function. It is clear that there are many tools that could provide valuable insights into the flood risks across the country, and could be used to produce more robust emergency plans. However, this would require additional investment of finance and time.

3.3 Tarascon case study, France

3.3.1 Background to the area

The case study chosen for France was the city of Tarascon and the lower part of the Rhone catchment. The downstream part of the biggest French river is prone to three kinds of floods: fluvial floods of Rhone and its tributaries (i.e. the Gard and Durance River), the overtopping of canals such as the Viguerat canal which is an irrigation canal and the possibility of dam failure from structures located on the Durance River (e.g. the Sainte-Croix Dam and Serre-Ponçon Dam). An aerial view of Tarascon is shown in Figure 3.11.

The Rhone River is bordered by system of dikes which is currently being reinforced after numerous failures over the last 15 years. Syndicat Mixte Interrégional d'Aménagement des Digues du Delta du Rhône et de la Mer (SYMADREM) is the authority that is in charge with the maintenance of the dikes; however, this authority does not have any responsibility for emergency management of floods.

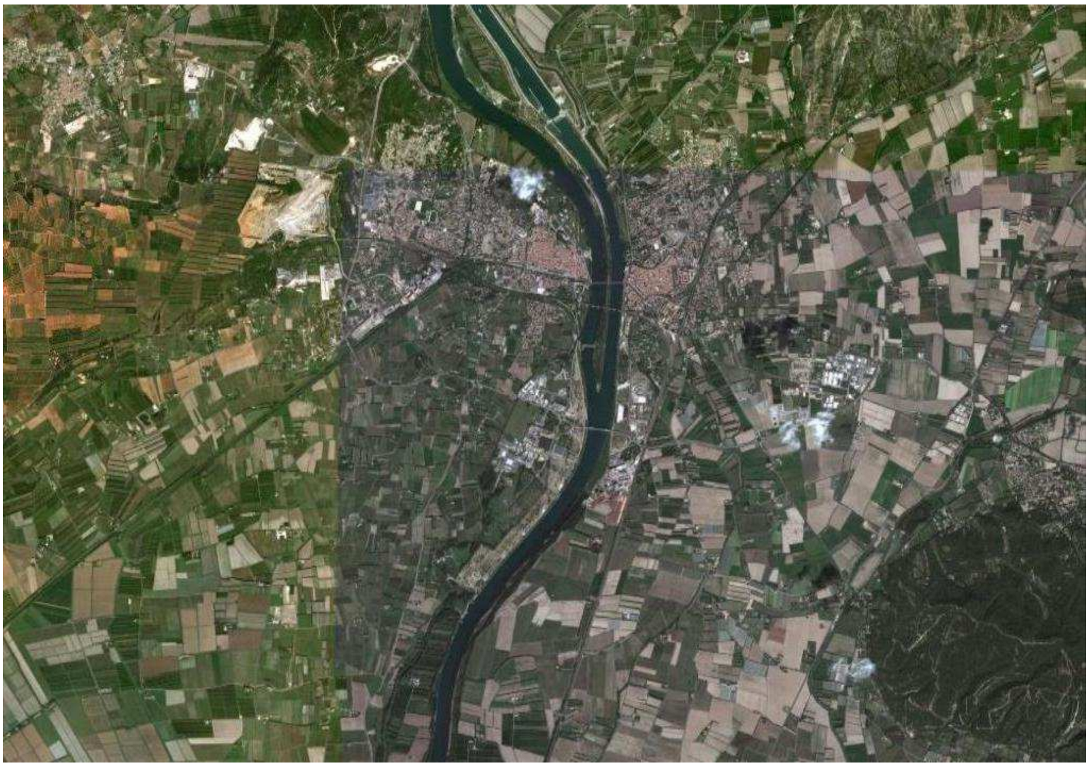


Figure 3.11 Aerial view of Tarascon, France

Two historical flood events have set the reference levels in terms of protection against floods. Before 2003 the "reference flood" was the flood of 1856 which devastated the Rhone valley and many other rivers in Europe. Many mitigation measures such as flood defence dikes were constructed or rebuilt following these floods. In 2003 the biggest floods since 1856 resulted in nine fatalities and caused more than one billion Euros worth of damage. Dikes that had not been repaired and well maintained failed in many places.

There are no emergency plans that cover a flood event over the whole Rhone delta. The Rhone Delta is divided into numerous administrative entities including more than 30 municipalities (i.e. communes), three Departments and two Regions (i.e. Languedoc-Roussillon and Provence-Alpes-Cote-d'Azur (PACA)). After the assessing the flood emergency management plans in the area it was decided to focus on the commune of Tarascon.

A flood emergency management plan called a Plan Communal de Sauvegarde (PCS) has been in place in Tarascon for several years. The municipality has developed a flood warning system that is recognized as being efficient. Nevertheless, the application of the FIM FRAME method to the PCS highlighted some gaps that the application of some tools could partly fill. The application of tool addressed two key issues:

- How to reduce the residual risk of people living in the Segonnaux which is the area between the River Rhone and the dikes;
- The impact of an extreme event (0.1 % probability flood) including breaches in the dike system.

The team chose to test a flood risk to people model on the western part of the Rhone Delta in the Gard Department to assess the residual risk to the population living in the area. The situation in this area is representative of the situation in many of the River Rhone floodplains. Several scenarios were tested using the flood risk to people model.

3.3.2 Application of the FIM FRAME method to Tarascon – Step 1 - Appraise

The FIM FRAME method to assist with assessing and improving flood emergency planswas applied to Tarascon's Plan Communal de Sauvegarde (PCS). The scoring of the PCS plans was performed by the University of Montpelier III. The results were presented and discussed at a workshop hold in Tarascon on the 4 January 2011. The aims of the workshop were:

- To launch a discussion on the shortcomings of the PCS of the city of Tarascon.
- To provide a basis for discussion on emergency planning issues that might lead to potential actions to implement and how they could be addressed.
- To gain feedback on the FIM FRAME method and recommendations for improving it

At the workshop an introduction to the FIM FRAME method was given as well as a presentation of the results of the scoring of the PCS using the developed metrics. Ten people responsible involved for emergency planning attended the workshop. They were from the:

- City of Tarascon local authority
- Police
- Fire brigade

3.3.3 Case study application: Step 2 Tackle

The second part of the workshop was dedicated to applying the FIM FRAME to two areas chosen by the attendees. These were:

- Flood hazards maps
- Flood forecasting and warning

The above two metrics were chosen because they were perceived to be problematic by the stakeholders in terms of emergency planning. Two groups worked on each of these areas using the FIM FRAME method that involved producing an entity diagram, cross table and action table. The entity diagrams produced for flood hazard maps and warning systems are shown in Figures 3.12 and 3.13 respectively.

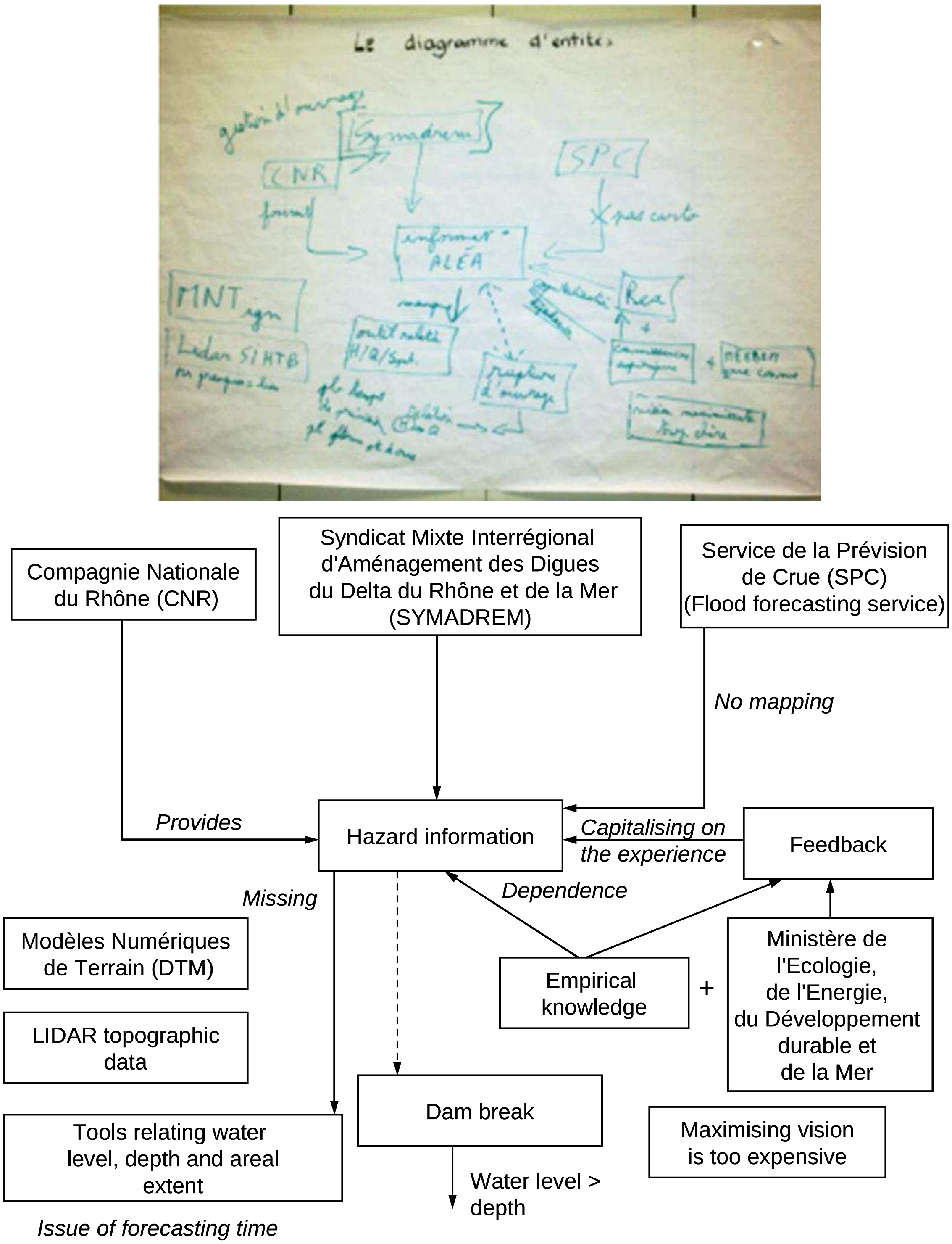


Figure 3.12 Entity diagram for flood hazard mapping

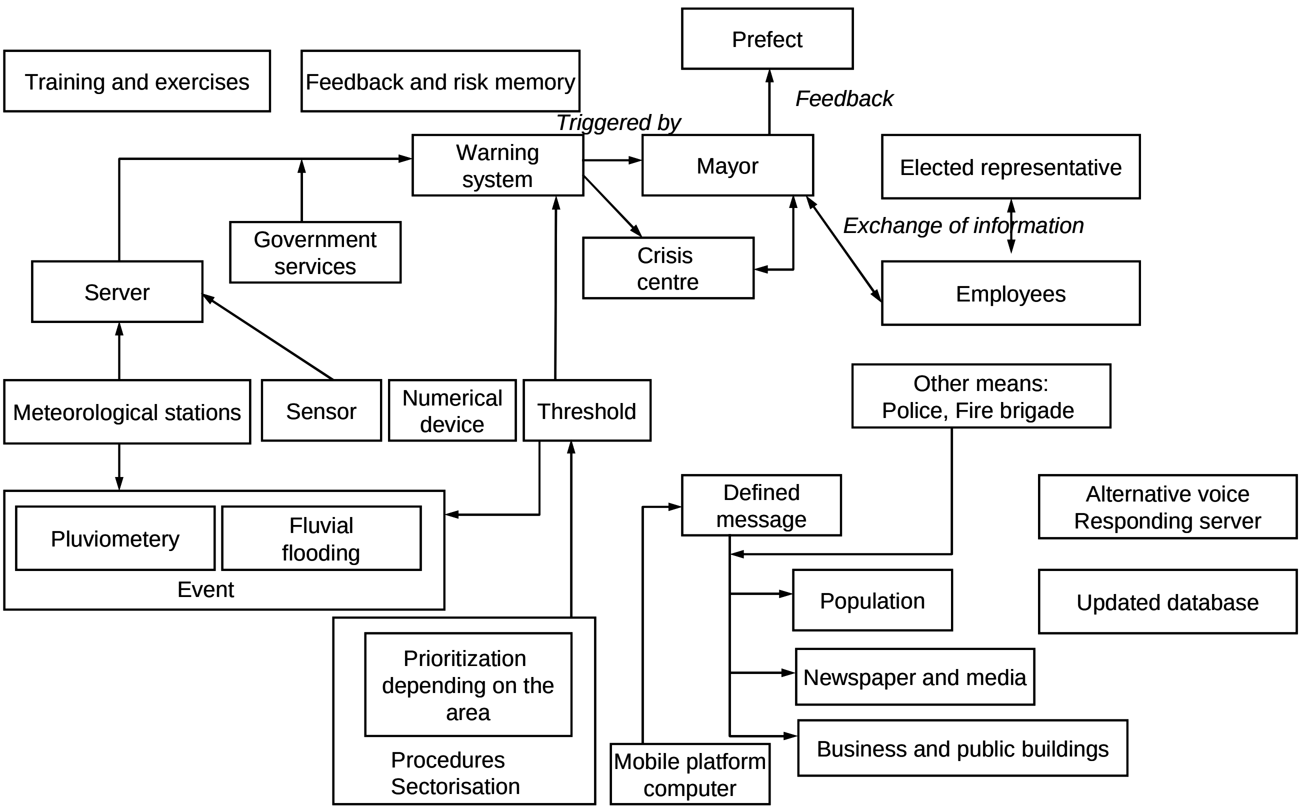
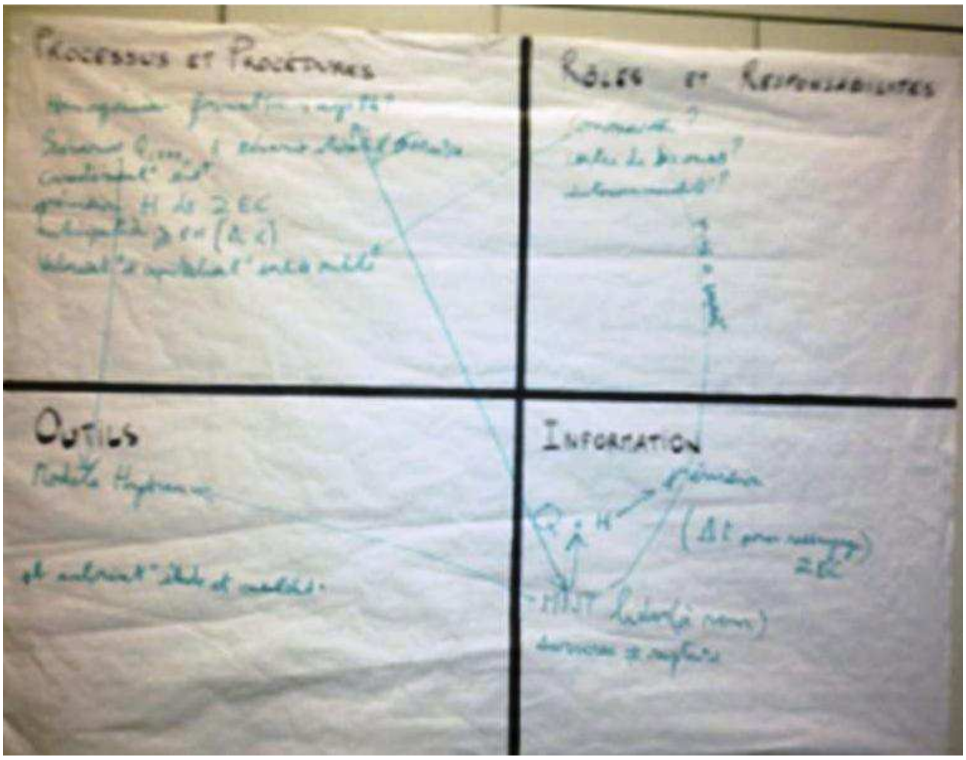


Figure 3.13 Entity diagram for flood forecasting and warning

The first breakout at the workshop gave rise to several debates among the attendees. It was the opportunity for the facilitators to understand better the local crisis management context and especially to have an overall view of the situation and to map the different processes that characterizes the PCS. For the flood hazard mapping the workshop highlighted the existence of considerable information concerning the flood hazard. However, this information is held by a number of different organisations and is not well disseminated. It was found that the stakeholders' knowledge of flooding was often based on previous large historical events. The fire service stated that they required hazard maps of more potential flood scenarios and also more extreme events (e.g. the 1 in 1,000 year annual probability event). Mitigations measures, although some times costly, for this extreme events need to be considered. New information is needed to assess the potential consequences of inundation as the result of the breaching of dikes.

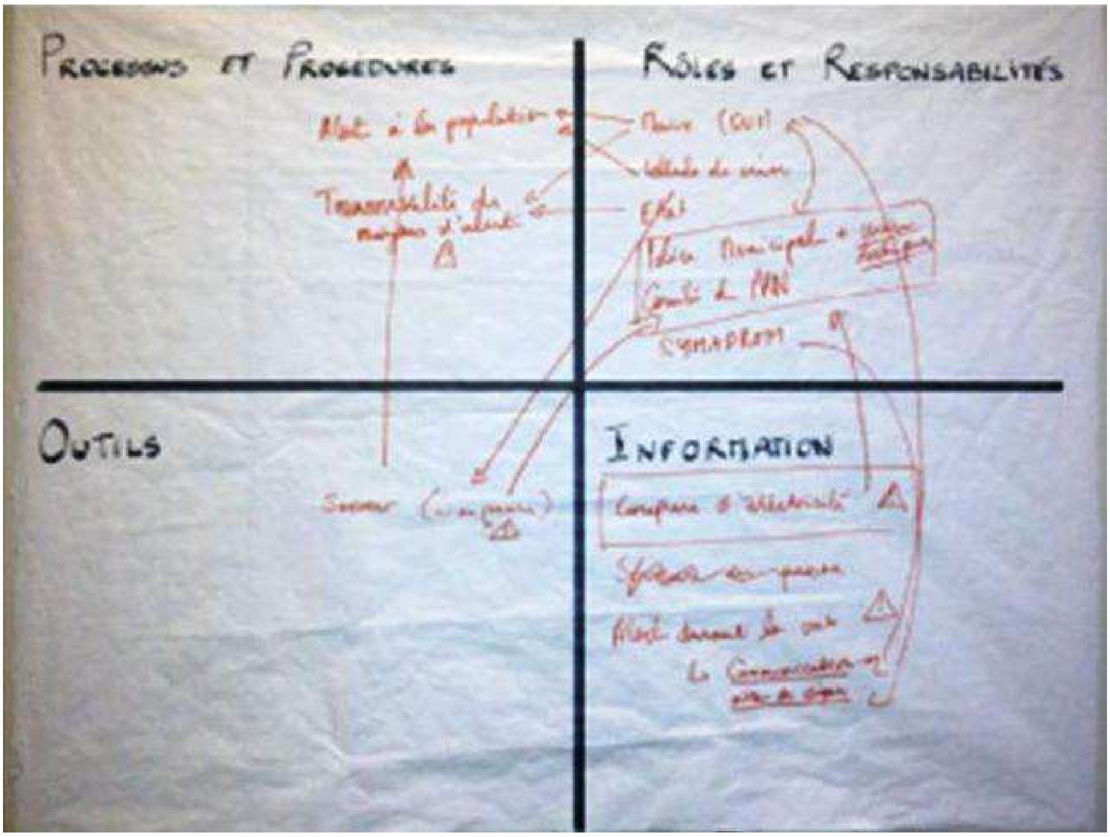
From the entity diagram, the various processes and procedures were identified, and inserted in the first quadrant. These were then assessed on the basis of who was responsible for them, what information was required, and whether any tools or other technology was used or needed. The resultant tables are presented in Figures 3.14 and 3.15 respectively.

This step of the FIM FRAME method was the opportunity for the attendees to clarify the different issues observed in the previous step. Regarding the metric "Flood hazard map", the first issue was to emerge was the funding and the future enhancement of the hydraulic studies already carried out on the watercourses that affect Tarascon. Several studies have been carried out by various organisations on that have not always been relevant to the stakeholders' requirements. It was noted that the warning thresholds were not appropriate. It appeared that Tarascon council has a need for flood hazard mapping at different flows, possibly at an interval of 500 m^3/s with the different water levels and inundated areas shown for each flow. Currently such hydraulic modelling results are not available. Many stakeholders mentioned the need to have a more extreme flood event mapped (e.g. the 1 in 1,000 annual probability event). Trascon council currently uses the 2003 flood, which has a return period of less than 1 in 100 years, as their "benchmark" for crisis management strategies.



Processes and procedures	**Roles and responsibilities**
- Standardize training - Map in 1 in 1,000 year event and scenario for 500 m^3/s flow - Characterization of events - Water level forecasts for the flood zone - Warning time > 8 hours - Promoting of and capitalising on tool outcomes	- City council - Fire Brigade - Local communities
Tools	**Information**
- Hydraulic model - Issue of promotion and consolidation of the studies	- Flow + depth = Forecast - LIDAR based digital terrain model

Figure 3.14 Cross Table for ‘Flood Hazard Map’



Processes and procedures	Roles and responsibilities
- Population warning - Across the board approach for warning	- Mayor - Crisis centre - French Government - Police and technical services - Committee for the prevention of natural hazards - SYMADREM
Tools	**Information**
- Server (if broken)	- Power cut? - Warning during crisis - Communication with dikes

Figure 3.15 Cross Table for ‘Flood Warning’

3.3.4 Stakeholders’ feedback on the FIM FRAME method

The application of FIM FRAME method helped to facilitate useful discussions concerning the issue of emergency planning in Tarascon. The table of metrics was recognized as a good “check list” for an initial assessment of the PCS plan. The attendees did not contest the first appraisal of the PCS plan. The entity diagram was found useful by the stakeholders because it structured the ideas around a specific issue. The analysis of the metrics using the entity diagram and cross-tables was relatively straight forward for professional emergency managers such as firemen, but some times more difficult for “non-specialists” such as policy makers. The attendees indicated that the FIM FRAME method would be used mainly for assessing existing plans. The workshops did not test the use of the FIM FRAME method for development of a new plan. It was found that owing to time constraints it was best to use the method to analyse the “weakest” metrics rather than all 22 metrics.

3.3.5 The gaps in the plan found using the FIM FRAME method

Tarascon municipality is heavily involved in emergency management. The municipality and firemen services have invested in human and material resources to protect them from floods from the Rhône River. It is clear that flood risk management is at the heart of concerns in the municipality, not only because of its exposure to risk, but also because the municipality wants to promote the demographic and economic development of Tarascon by opening up some areas to development that are currently at risk of flooding. Tarascon has six people (i.e. elected representatives and firemen) that are aware of the flood risk and have significant experience of previous emergencies such as the 2003 flood event. By choosing to invest in several advanced tools the municipality has increased its capacity to respond and to manage future flood events. However, there remain some shortcomings and gaps in the municipality’s emergency planning for floods as demonstrated by the metrics that were investigated as part of the workshop.

The Table 3.5 shows the initial scores of the Tarascon emergency plan and indicates the possible actions to improve the score of each metric among those which were considered during the workshop. The scores of each metric have been revised considering the objectives of the workshop and scoring the metrics according the criteria defined in WP1 of this research.

3.3.6 Potential actions that could improve the plan

After applying the FIM FRAME a plan of action was drawn up via which the emergency plan could be improved. These are summarised below:

- Improve the knowledge of the elements at risk and the vulnerabilities of flood prone areas via the creation of new mapping
- Improve the definition of the trigger levels i.e. the actions to be taken at specific levels or flows in various rivers needs to be defined
- There needs to a compilation and standardisation of the existing hydraulic studies and models that have been carried out
- The inundated areas and water depth need to be related to the flow in the river. For example, it would be useful to have flood hazard maps produced at 500 m^3/s interval increases in the flood flow
- Extreme flood scenarios such as the 1 in 1,000 year annual probability flood need to be mapped
- In terms of the warning system there were a number of actions that need to be carried out. These include:

Table 3.5 Potential actions to implement for each metric and improved score of the plan

Metrics	Initial Score			Initial Scoring	Potential action	Potential score
	Room for improvement	Acceptable	good			
Aims and objectives of plans			X	3	Not addressed	3
Target audience and updating			X	3	Not addressed	3
Details of previous floods	X	X		1	Reports to share the knowledge of previous floods	2
Flood hazard map	X		X	1	Flood hazard and potential aftermaths mapping of a flooding for each critical level oft he Rhône river (every 500 m3.s-1)	3
Flood Warning		X	X	2	To link water depths to a flood trend with maps of affected zones	2.5
Risk to people	X	X		1	Maps of people living in flood prone zones (ségonnaux)	2
Risk to vulnerable people	X	X		1	To improve the registering of vulnerable people	2
Flood risk to residential properties		X		2	Not addressed	2
Flood risk to business	X	X		1	To strenghten relationship between prevention and crisis management i.e. plans to protect businesses	2
Flood risk to critical infrastructure	X			1	Not addressed	1
Potential for NaTech hazards	X			1	Not addressed	1
Evacuation routes		X	X	2	New maps for crisis management	3
Shelters/Safe havens			X	3	Not addressed	3
Relationship with complementary emergency plans		X	X	2	Enhance exchanges between	3

					stakeholders (compatibility of data)	
Communication with other agencies		X	X	2	Enhance the cross-knowledge of procedures, needs and objectives among stakeholders	2.5
Communication with the public		X	X	2	Updating of the calling list	2.5
Management of the media			X	3	Not addressed	3
Assumptions made by the plan	X			1	Not addressed	1
Plan activation			X	3	Triggering levels to confirm by relation depth/affected areas (see metric : flood hazard)	3
Actions, roles and responsibilities			X	3	Improve cross competences in emergency management teams	3
Recovery		X	X	2	To help farmers to resume activity after disasters by helping them pumping and gathering cattle… A census of materials available is needed	2.5
Training and exercises	X			1	Not addressed	1
TOTAL	**Initial score**			**1.78**	**Potentiel score**	**2.21**

3.3.7 Application of tools to address gaps and issues

In order to address the gaps two tools were applied:

- The application of LIDAR digital terrain model which offers more accurate topographic data in the vicinity of Tarascon
- The application of the Flood Risk To People method to assess the potential impacts of extreme events.

Application of the LIDAR data

A LIDAR based digital terrain model (DTM) was available in the unprotected floodplains in the vicinity of Tarascon. This DTM allowed the services responsible for emergency management to have a better knowledge of the topography and which areas should be to evacuated first and which areas can be used as shelters. An analysis of the evacuation routes in the area to be made.

Application of the Risk To People method

The Flood Risk to People method was also applied as part of the case study to get an idea of the number of injuries and fatalities that may occur during a large flood. In December 2003 there was a flood event in which one person died. When the Flood Risk People method was applied to this flood the number of fatalities is estimated to be between one and two people with 31 people injured.

The Flood Risk to People method was also applied to the 0.1% annual probability flood event, including a dike breach. The hydraulic conditions are not deeply modified according the return period considered. The sensitivity of the Flood Risk to People method to changes in the demographic data was tested. This was done by simulating a doubling in the number of people aged over 75 and a doubling of the number disabled people by 2050. The Flood Risk to People method appeared to be more sensitive to the socio-economic variables than to hydrological variables. The number of fatalities rose from 5 to 10 with demographics changes. Table 3.6 shows the results of the Flood Risk to People method for the 2003 flood event and the 0.1% annual probability flood

Table 3.6 Results of the Flood Risk to People method for three flood scenarios of the Rhone floodplains in the vicinity of Tarascon

Scenario	Injured people	Fatalities
2003 event	34 to 35	1 to 2
0.1% annual probability flood with the present day population	77 to 78	4 to 5
0.1% annual probability flood event with 2050 demographics with a doubling in the number of disabled people an people aged over 75	154 to 155	9 to 10

Figure 3.16 shows the geographical distribution of fatalities for the 0.1% annual probability flood with the 2050 demographics as outlined above.

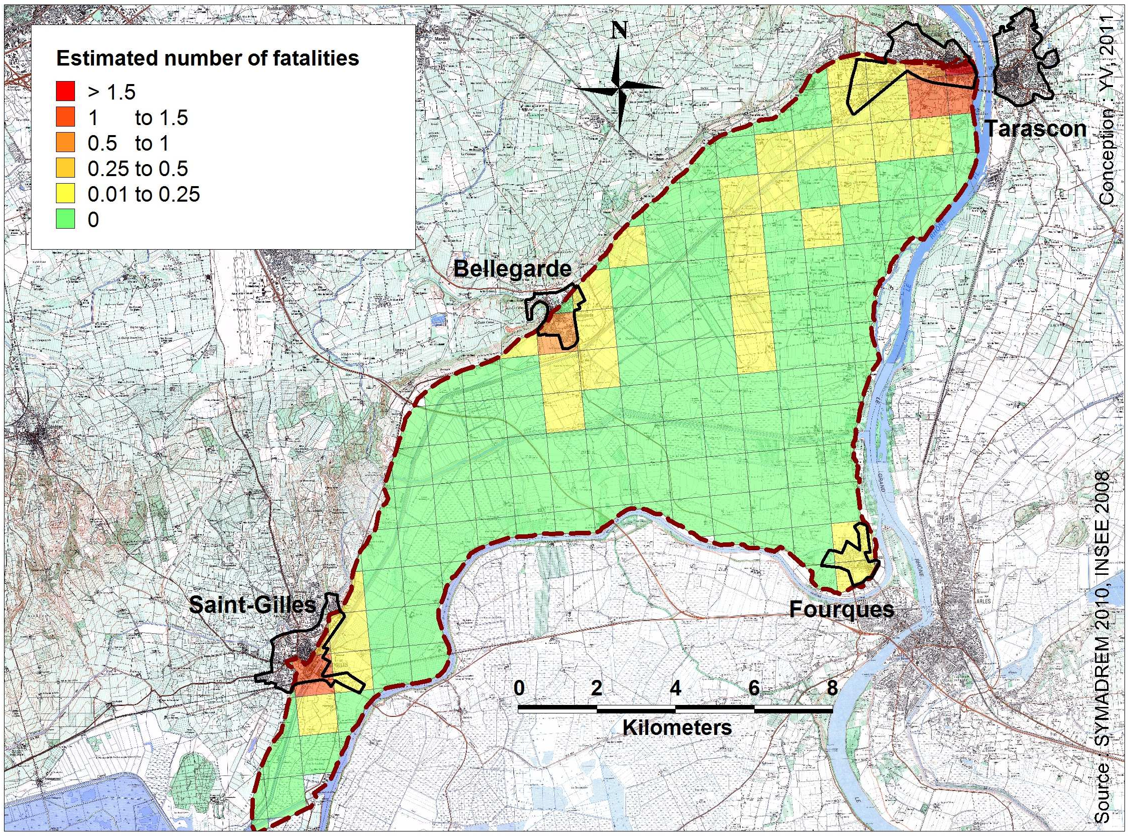


Figure 3.16 Outputs from the Flood Risk to People in the vicinity of Tarascon

3.4 Dordrecht case study, the Netherlands

3.4.1 Background to the case study area

The city of Dordrecht has a population of around 120,000. The city is located on a 90 km^2 island which is at risk of flooding from the tidal reaches of the Rivers Meuse and Rhine shown in Figure 3.17. Part of the city is situated in flood prone areas, not protected by dikes. Flooding is caused by a combination of high river discharges and sea levels, although flooding has not occurred since the night of 1 February 1953 when the South-West of the Netherlands was struck by a large flood killing around 1,800 people in the region

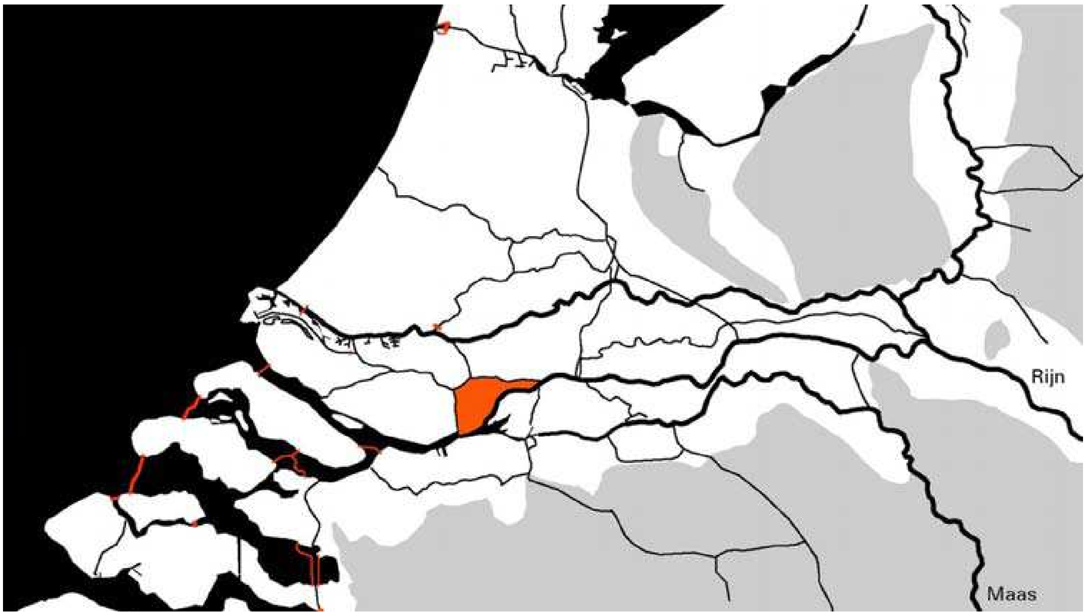


Figure 3.17 Location of the city of Dordrecht in the Netherlands

This island lies east of Rotterdam and is surrounded by several rivers. This island houses the city of Dordrecht. The island is mostly protected by dikes. The ring of dikes and flood defences protecting the largest part of the City of Dordrecht as is illustrated in Figure 3.17.

If the dikes in the vicinity of Dordrecht fail because of an extreme water level event, the island will become flooded quite rapidly and large water depths are expected. For 13 representative breach locations, the consequence of flooding has been evaluated. The maximum water depths on the Island would reach up to 4 m. The major part of the island would be under 2 m to 3 m of water. This is shown in Figure 3.18.

Owing to the limited exit points from the island, evacuation is complicated and the risk of casualties is high in the event of a flood. Figure 3.19 shows the exit points by road from the island. Evacuation possibilities will be further limited because the surrounding areas will also be in the process of evacuation, increasing the pressure on the main roads out of the flood threatened area. An early study on risk of casualties under changing climate conditions (Klijn et al, 2007) calculated the number of expected casualties for the current situation assuming that 10% to 40% of the inhabitants remained on the Island. The number of expected casualties was estimated at approximately 400.

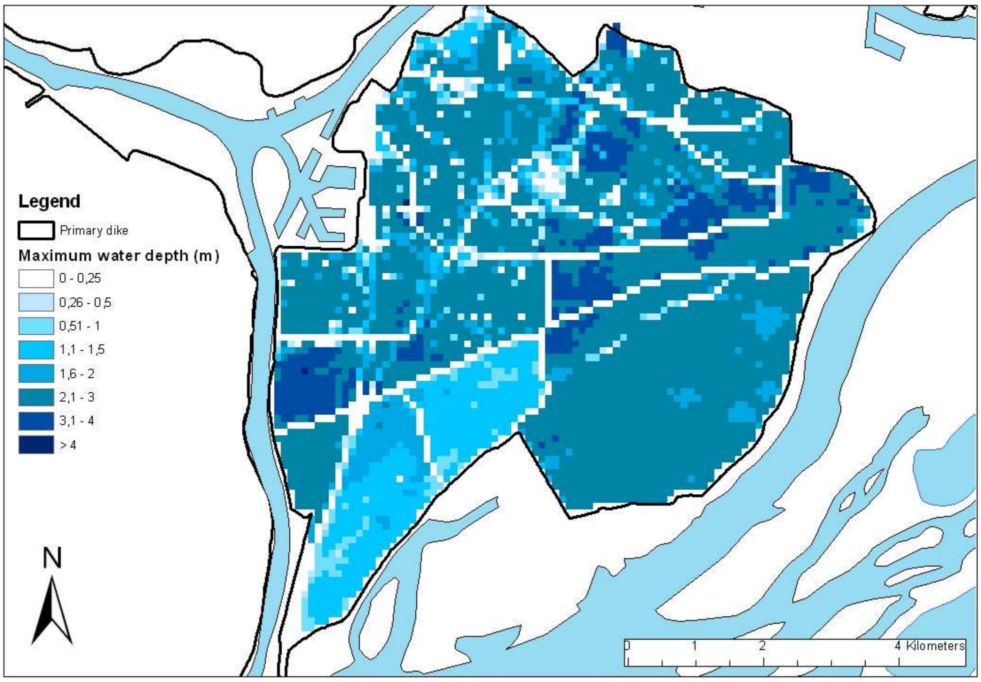


Figure 3.18 Compilation of maximum water depths for Dordrecht evaluated for 13 breach locations

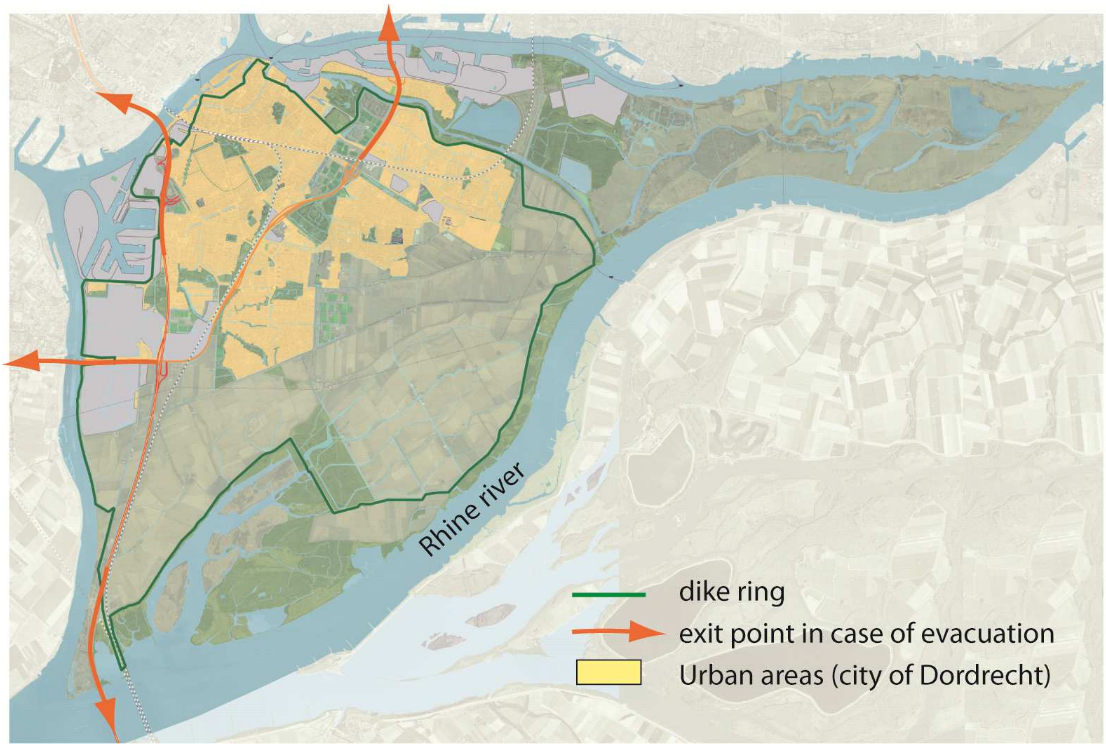


Figure 3.19 The Island and city of Dordrecht and the exit points in case of evacuation

If confronted with such a scenario, the regional police and fire departments would be involved in the so-called “veiligheidsregio (Safety Region) Zuid- Holland zuid”. Breaches in the flood defence system will cause the island to fill up rapidly with water, because the inner dike area is below river level and large water depths are possible. Preparing for an evacuation is an important issue for this area. The emergency plan assumes a total evacuation of the island. Experts and emergency planners expect this to be an impossible task, owing to the number of people and time it would take to evacuate them.

Three flood event management plans cover the Island of Dordrecht:

- *Regionaal Basisplan Overstromingen Zuid Holland Zuid, algemeen deel (RBO), v2.8*
  General flood emergency plan (FEMP) for the region in which Dordrecht lies. The plan was developed by the Safety Region.
- *Regionaal Basisplan Overstromingen Zuid-Holland Zuid, specifiek deel dijkring 22, Eiland van Dordrecht, v2.7*
  This plan is in addition to the general FEMP and focuses on the Island of Dordrecht. The plan was developed by the Safety Region.
- *Hoogwaterbestrijdingsplan gemeente Dordrecht januari 2010*
  This plan focuses on the areas unprotected by flood defences.

3.4.2 Application of the FIM FRAME method to Dordrecht – Step 1 - Appraise

The scoring of the plans, which forms Step 1 of the FIM FRAME method know as “Appraise” was performed by the project team. The results were presented and discussed at a workshop held in the Safety Region. The aims of the workshop were to:

- Provide feedback on the FIM FRAME method and ways it could be improved
- Provide a basis for discussion on emergency planning issues for the Island of Dordrecht that might lead to potential actions to tackle some of the identified issues

At the workshop an introduction to the FIM FRAME method was given as well as a presentation of the results of the scoring of the emergency plan with use of the metrics for the region of ZHZ. The second part of the workshop was dedicated to applying the FIM FRAME method with an emphasis on Step 2 known as “Tackle”. The workshop was held at the Safety Region’s main office in Dordrecht. There were seven people involved in emergency planning who attended the workshop. They were from the:

- City of Dordrecht
- Province of South Holland
- Police department
- Fire brigade
- Water board Hollandse Delta

The workshop acted as a starting point for the case study, so the focus was on the topics related to evacuation for the area of the Island of Dordrecht. The following topics were selected by the attendees for further analysis with use of the FIM FRAME method:

- Evacuation of the people in the areas unprotected by flood defences towards the areas protected by flood defences
- Evacuation of the people in the areas protected by flood defences to areas outside of the island

There were two groups each worked on different metrics drawing up the entity diagrams, cross tables and action tables as outlined in the FIM FRAME method.

The two plans were scored complementary to each other with use of the metrics. The results for the Island of Dordrecht plan are shown in Table 3.7. The project team compared the lower scoring metrics to the requirements for a high score as defined in Step 1 of the FIM FRAME method. The last column in Table *** indicates possible actions to improve the scoring of the specific metric to meet the requirements for a high score. These actions were discussed with the Safety Region. It is seen that for several metrics the scoring can be improved by adding information that is also readily available e.g. target audience and updating. Several metrics require that maps are included where information is now only available through text or tables e.g. risk to people. This requires simple GIS actions. For some metrics the process needs further evaluation, e.g. recovery. Here step 2 in the FIM FRAME method can help. The project team indicated where the use of advanced tools could have more insight and more useful information e.g. for evacuation. Four types of actions have been listed in Table **** as follows:

- Blue: Add information that is already available to the plan.
- Green: show information that is already available on a map and add to the plan (GIS action)
- Red: further research is required (e.g. use of advanced tools, Step 3 in the FIM FRAME process).
- *Process needs to be analysed in more detail (Step 2 and 3 in the FIM FRAME method).

Table 3.7 Scoring of the flood emergency plans for the Island of Dordrecht

Metric	Room for improvement	Acceptable	Good	Score	Improvement of scores
Objectives, assumptions and target audience					
Aims and objectives of plans			●	3	
Target audience and updating		●		1.5	- Include updating procedure in the plan including notification of target audience. - Plan has a version number. Add the date of the plan.
Assumptions made by the plan			●	3	
Organisation and responsibilities					
Actions, roles and responsibilities			●	3	
Recovery	●			1	- * Develop an overview of the required recovery activities and how recovery should be managed. - Gain insight into draining time for the Island of Dordrecht for the different flooding scenarios. Use can be made of 2D flooding simulation tools.

Metric	Room for improvement	Acceptable	Good	Score	Improvement of scores
Training and exercises	•			1	A training and exercise program already exists. Uptake the requirements and procedure into the plan or uptake clear link to the plan.
Plan activation			•	3	
Communication					
Communication with other agencies			•	3	
Communication with the public	•			1	Event communication is described in a separate communication plan . This plan addresses the processes and responsibilities, but does not specify communication strategies, messages e.g. - Include clear links to the communication plan. - * Check if the communication plan is sufficient for a flood situation. E.g. is the warning coupled to the threshold levels of activation of the plan.
Management of the media	•			1	Same as for communication with the public.
Flood Warning	•			1	Flood Warning is linked to the plan activation stages which are linked to the river and sea water levels. Flood warning during actual flooding is not addressed in the plan. * Add levels of flood warning with details of the areas flooded at each level and shown on a map.
Relationship with complementary emergency plans		•		2	Add schematic overview of the relationship with complementary plans. This should include the communication plan mentioned earlier.
Evacuation					

Metric	Room for improvement	Acceptable	Good	Score	Improvement of scores
Evacuation routes	•			1	- * Evaluate different evacuation strategies. - * Define evacuation routes. Include which roads likely to be closed and accessibility in time for vehicles. - Map the location and the elevation of the routes in combination with the water depth maps.
Shelters/Safe havens	•			1	- Locate existing buildings which can be used as shelters both on the island as outside of the island. - Evaluate if sufficient shelter locations are available. - Include in plan the location, capacity and facilities of the shelters.
Flood hazard					
Flood hazard map			•	2,5	Add map showing flood velocities.
Details of previous floods	•			1	Not relevant to this emergency plan because no recent enough previous floods have occurred.
Flood risk to receptors					
Risk to people		•		2	A list of number of people per postal area is already available. - Show these numbers on a map and combine with the water depth map. - Casualty risk maps have been developed. Add these to the plan.
Risk to vulnerable people	•			1	A list of number of vulnerable people is available per postal area. - Show locations where vulnerable people are concentrated on a map and combine with the water depth map. - Show the number of vulnerable people per postal code on a map and combine with the water depth map. - * Add response strategy

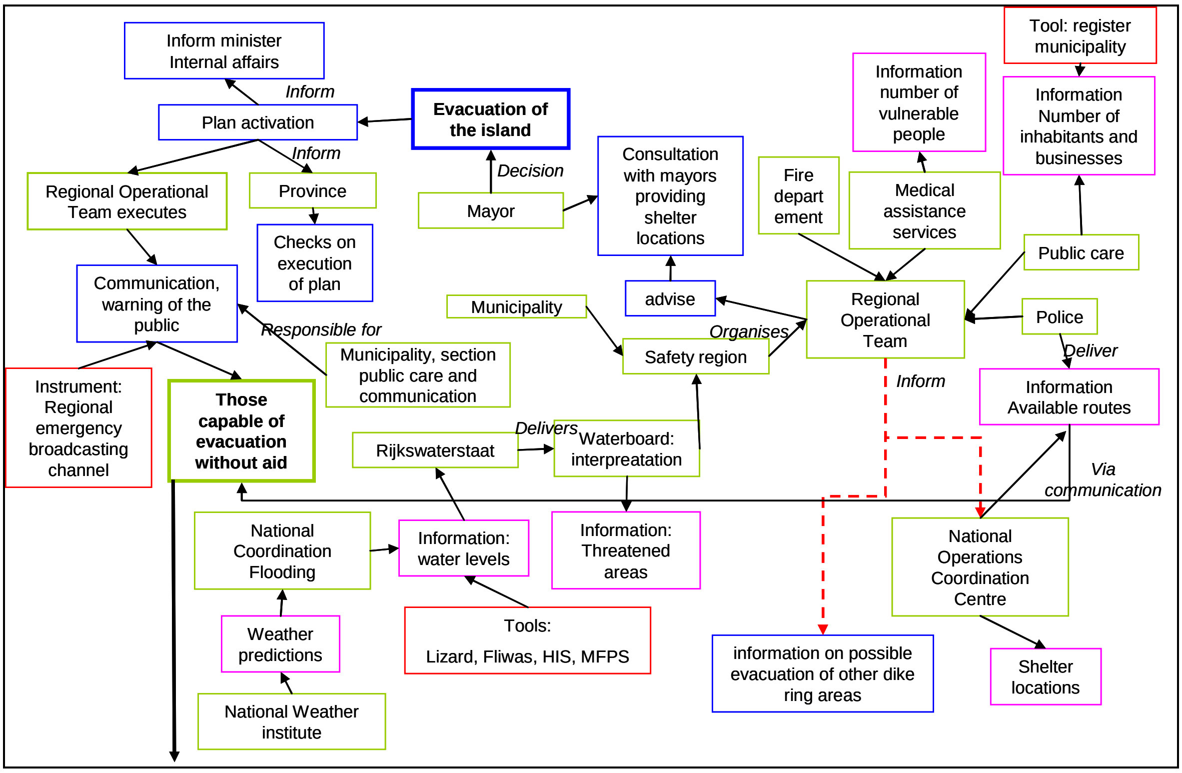
Metric	Room for improvement	Acceptable	Good	Score	Improvement of scores
Flood risk to residential properties	•			1	- Show the residential areas on a map and combine with the water depth map. - Map number of properties in combination with water depth maps.
Flood risk to business	•			1	- Show location of businesses, types of businesses on a map an combine with water depth maps. - Potential damage maps are already available. Add these to the plan.
Flood risk to critical infrastructure	•			1	The plan already includes a list of vulnerable objects. - Add to this list and show on a map in combination with the water depth maps. - Analysis of impact of failure of critical infrastructure.
Potential for NaTech hazards	•			1	The plan already includes a list of environmentally hazardous businesses. - Show these on a map in combination with water depth maps. - * Add response strategy
Average score				**1.6**	**Room for improvement**

It is seen that especially aspects of the topics ‘Communication’, ‘Evacuation’ and ‘Flood risk to receptors’ have low scores. The attendees noted that the topic ‘Communication’ is addressed in a related plan specifically on communication. This plan is about processes and procedures and is not specifically focused on flood hazards. This plan was not available to the facilitators for scoring.

3.4.3 Case study application: Step 2 Tackle

During the workshop an entity diagram and cross table were constructed to evaluating the topic relating to the evacuation of people from the Island of Dordrecht to safe areas outside the island. In addition a start was made for the action table.

The resulting entity diagram is illustrated in Figure 3.20. The gaps are indicated with a dotted line. Four colours were applied to indicate a process (blue), people/organization (green), tool (red) or information (pink).



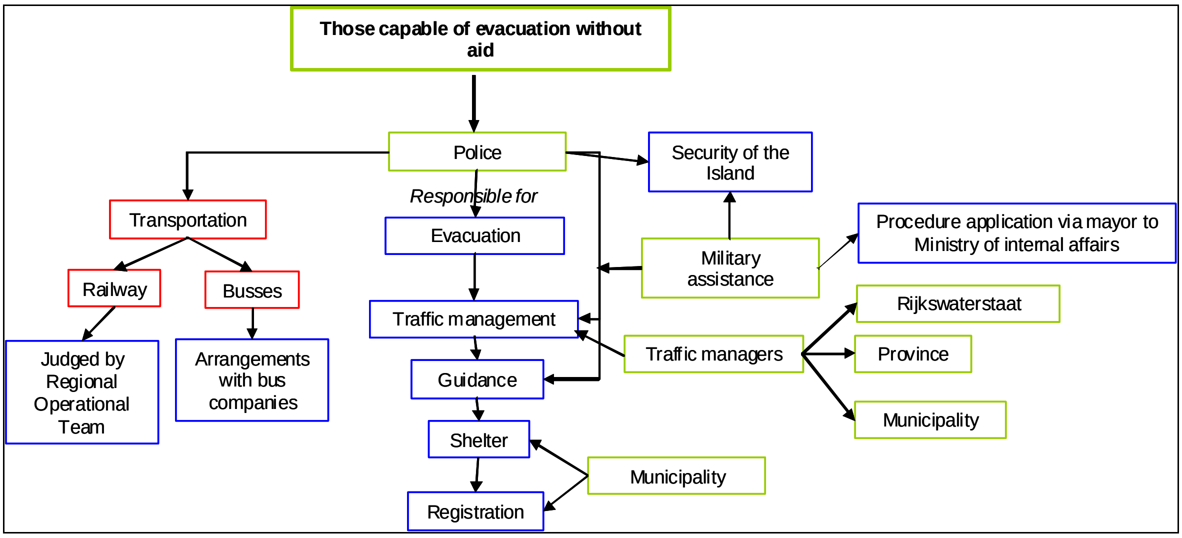


Figure 3.20 Entity diagram evaluating the topic relating to the evacuation of people from the Island of Dordrecht

The participants were asked to describe the perfect evacuation process and identify gaps with respect to the current organisation of the evacuation process. The starting point was describing and analysing the current organisation. From the entity diagram the only identified gap was the communication from the regional to national operations. The focus was mainly on the process (blue) and organisations and their responsibilities (green). The identified tools give an insight into the flood threat, required resources and instruments. No tools to improve the plans have been identified in this stage yet. The next step was the development of two cross tables shown in Figures 3.21 and 3.22 respectively. The identified gaps are indicated in red.

Processes & procedures Advising on evacuation	**Roles & responsibilities** Regional Operational Staf + staf sections + partners (National water board, Regional water board, Utility companies Mayor (receiver) + policy team Regional operational leader GBT (head of communication) National Operation Crisis Coordination
Tools (enhancing technology) City administration/register FLIWAS/HIS Tool to work out scenario's Evacuation calculator Digital accessibility map (national databases) Checklist communication strategy	**Information** Cause: flood threat Possible scenario's and effects • info number of citizens and companies • info number of self-supporting citizens Strategies, options

Figure 3.21 Cross table evaluating the process of 'advising the mayor'.

Processes & procedures Flood information: • Pre-warning • Warning • Alarming	**Roles & responsibilities** Rijkswaterstaat (alertering levels constructions) National Water boards (alerting levels for the areas protected by flood defences) National Coordination Flooding City (alerting levels for areas unprotected by flood defences)
Tools (enhancing technology) MFPS FLIWAS LIZARD Meteo systems DEM city 'Veiligheidstoetsing primaire waterkering'	**Information** Rivier dicharge and water levels Sea levels North sea, coast Prediction in time Area threated by flood for different scenarios Weather (storm) Elevation areas unprotected by flood defences Actual level flood defences

Figure 3.22 Cross table evaluating the process 'flood information'.

The cross table results show that processes and procedures as well as roles and responsibilities are well covered by the plans, but that the supporting information needs further elaboration. The attendees emphasized the need for flood scenario based information on flood risk (e.g. threatened area, number of citizens and companies). This kind of information is developed by research and engineering companies for the national government. In addition, the tools to develop this information require specialised expertise and knowledge. The Safety Region is therefore dependant on these organisations.

The attendees were asked to note the issues (red lights) which were identified from the cross table onto the action table. The action table was discussed, but due to time not further developed. The following issues were identified:

- Gaining insight into availability of evacuation routes
- Information on demographic numbers; vulnerable groups and to evacuate people, location of vulnerable people
- Being able to connect the different automated systems used by the different parties involved in emergency planning

3.4.4 Application of tools to address gaps and issues

Background

From the geographical location of the Island of Dordrecht means that evacuation of the island is not be feasible and that improving the evacuation and shelter possibilities could aid in reducing the flood risk for the Island. The application of the FIM FRAME method identified the issue of evacuation as a gap in the emergency plan for the island. The case study evaluated an alternative evacuation strategy making use of shelters on the island in which a number of people could find refuge and encouraging the remaining inhabitants to seek shelter in their own homes or tall buildings on the island. The currently strategy followed by the Safety Region is to attempt to evacuate everyone from the island.

The case study demonstrates the use of advanced casualty calculations and evacuation tools and methods to evaluate the different evacuation strategies. The results from this case can assist in improving the understanding of the evacuation process during a flood threat which in turn can be used to address the evacuation issues in the flood emergency plan for the island of Dordrecht. The calculations on the flood risks were executed by the Technical University of Delft within the context of the MARE project (Hoss et al, 2011). An analysis of the research with regards to the use of tools and the results was undertaken. In addition an interview was conducted with the Safety Region to assess to what extent the application of the tools and the outcome of the calculations could aid in improving the Flood Emergency Plan.

Application of tools

As part of the case study two evacuation strategies, the current evacuation strategy and the alternative strategy were evaluated with respect to their effectiveness. For the current situation it is estimated with use of the EvacuAid tool that it would be feasible to evacuate 15% of the people to safety. This percentage was determined in earlier studies (Maaskant et al, 2009). For the remaining people no measures are taken. For the alternative strategy it was estimated with use of the EvacuAid tool that owing to improved warning a higher percentage of 28% could be evacuated to safety. In addition it has been assumed that due to the system of shelter and improved communication, the mortality rate will reduce by 50%.

Sobek 1D2D

Sobek 1D2D is a flood hazard mapping tool and is used to simulate a flood event. It calculates flood characteristics such as the flood extent, water depths, water velocity, rate of rise and arrival time for a specific scenario. Figure 3.23 gives an example of a water depth map for a dike breach location on the east side of the Island of Dordrecht.

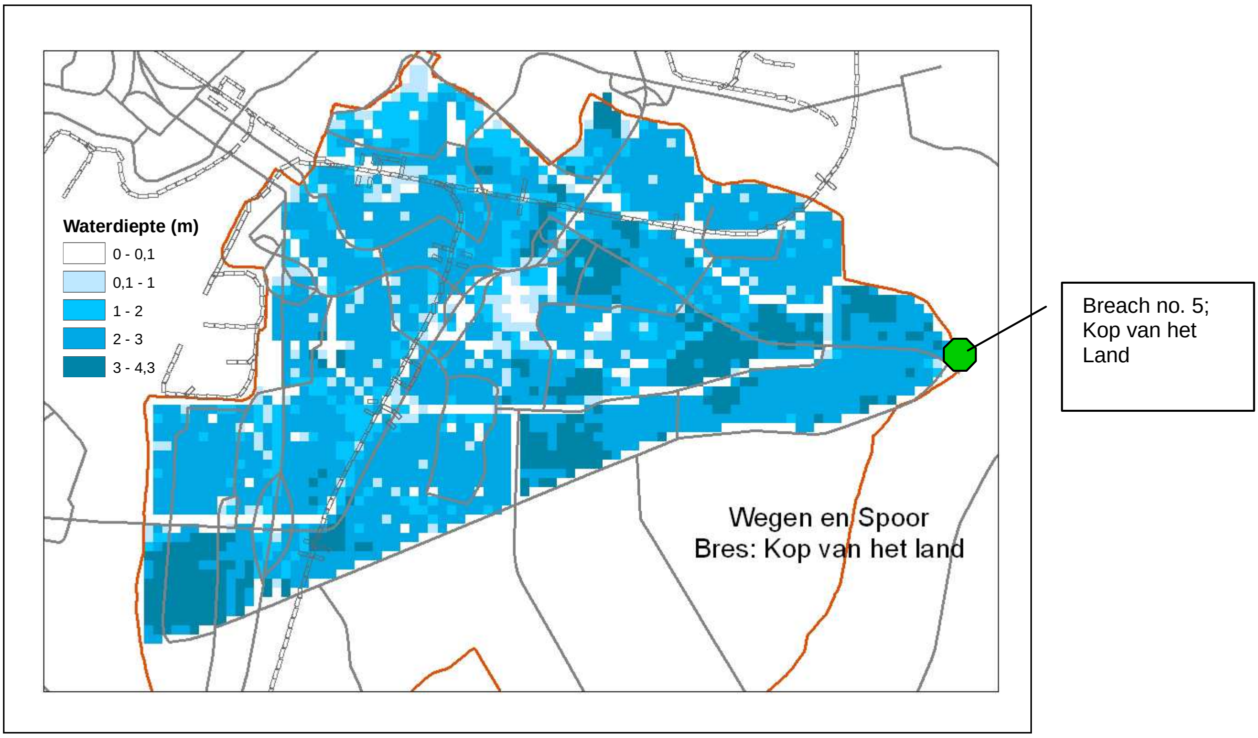


Figure 3.23 Water depth map for breach location no. 5; 'Kop van het Land

HIS-SSM
HIS-SSM stands for 'High Water Information System – Damage and Casualties Module'. The HIS-SSM is used to calculate direct and indirect damages and number of expected casualties for a flood scenario.

Evacuaid
EvacuAid determines through a probabilistic approach the expected value of the number of evacuated people for a certain evacuation strategy. It takes into account sources of uncertainty such as the type of threat (expected versus unexpected), behaviour of people, the chosen evacuation strategy and the effectiveness of use of infrastructure (Kolen et al, 2010). The average percentages of people evacuated for the alternative strategy, was determined using the EvacuAid tool.

RiskTool
The effectiveness of the two strategies is determined by the number of expected casualties and the flood risk to people. The flood risk is determined by the flood probability and the consequence of the flood. RiskTool combines the risks for different flood scenarios and determines the overall flood risk for a dike ring area (Thonus, 2008). It calculates the flood risk, the local risk (individual risk) and the group risk.

Summary of the results
Table3.8 shows the results for the expected annual number of casualties for the evaluated strategies. The alternative strategy using shelters shows a decrease of annual casualties of 66%.

Table 3.8 Expected annual number of casualties (EANC) for the evaluated evacuation strategies

Strategy	Expected annual number of	Reduction of risk of casualties

	casualties	(%)
Current strategy	0.42	-
Alternative strategy	0.14	66

The Local individual risk also improved considerable as is illustrated in Figure 3.24.

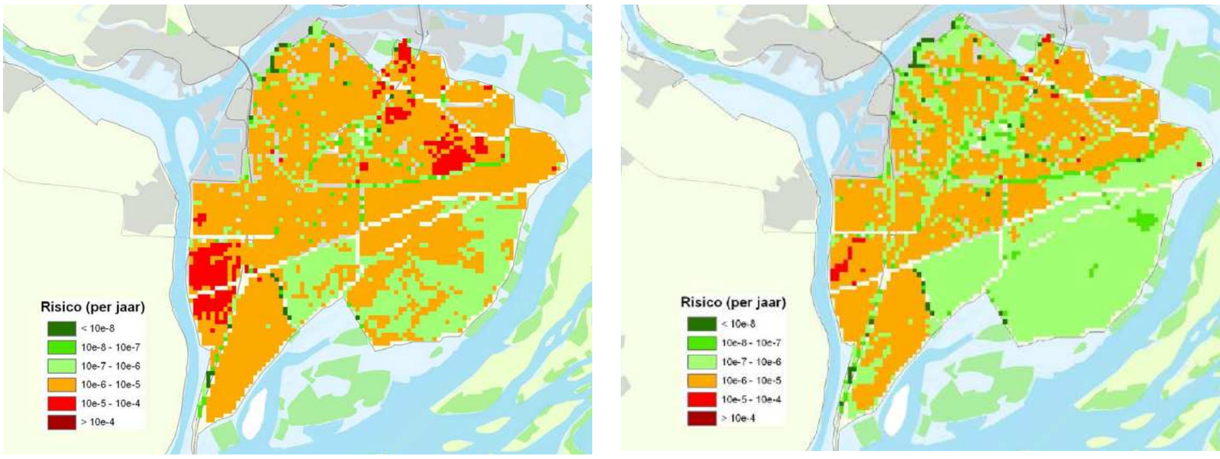


Figure 3.24 Local individual risk for current strategy (left) and alternative strategy

The results show that preparing for floods by assigning shelters can aid in reducing the number of casualties by 66%.

Potential use for improvement of the emergency plans

In recent years the research on evacuation calculation has improved and the tools and new insights can aid emergency planning considerable. The case illustrates the use of tools for evaluating the effectiveness of different evacuation and shelter strategies. These strategies need to be worked out in more detail e.g. by assessing which buildings are feasible to use as an emergency shelter during a flood and by assessing the required capacity of the shelters and resources needed to supply and staff the shelters. In addition evacuation routes to the shelters can be mapped out and evaluated on their accessibility during a flood.

An interview was conducted at the Safety Region to assess the applicability of the case results for improvement of the Regional Flood Emergency Plan. The results were seen as useful, but need to be elaborated further. The risk assessment was performed only for the island of Dordrecht. The emergency plans currently developed by the Safety Region are for the area for which the Safety Region is responsible. This includes a large part of the surrounding areas of the island as well. Similar calculations will therefore need to be performed for the region as a whole.

The alternative strategy is a progressive way of thinking. It is expected that time is needed for people to become accustomed with alternative strategies. The results from the case can act as an example and aid in getting commitment for the application of alternative strategies.

The interview also made clear that the people responsible for the development of the plans, are interested in the results and outcomes from studies and tools, but do not have the knowledge and people available to work with the tools themselves. Access to the results is therefore essential for improving emergency plans, but access to and use of the actual tools will not be required by the Safety Region. The gap in knowledge and tools availability can be overcome by facilitating information availability e.g. through centralised information storage or by bringing parties together.

As final remark it was noted that for correct use of results and outcomes of tools and studies, the end-user requires knowing which underlying assumptions were made and what the corresponding uncertainty is.

4 Summary of the outcomes of the workshops in England, France and the Netherlands

4.1 Workshop agenda

Each workshop held in the case study area followed approximately the same agenda. The various steps of the FIM FRAME method were introduced to the attendees including the expected outputs and the level of detail of the analysis. The model agenda used in the workshops is shown in Table 4.1.

4.2 Selection of the metrics to be discussed

The first discussion involved looked at the metrics that were developed as part of the research and the scores that the project team assigned to the plans after they had been assessed. In general the discussion and the choice of the metrics to analyse were made in a plenary session. The assessment of the plans using the metrics allowed their weak points to be identified and also provided criteria as to which metrics to focus on.

As part of the workshops possible actions were developed to allow the score of the chosen metric to be improved in the future. The metrics chosen in each workshop in the three countries are given in Table 4.2. These metrics were briefly considered by reviewing the relevant part of the plan (provided in a hand-out) and the given score was discussed. In the Netherlands, the issue of evacuation was seen as important by the stakeholders, whilst in France the attendees favoured issues concerning warning and flood hazard mapping. In England and Wales the metric discussed was “evacuation routes”.

In all the countries, discussion were held regarding what exactly the metrics covered. Before implementing the FIM FRAME method it was important that the stakeholders agreed on coverage of the selected metric. For example in Netherlands, the focus was on the topics related to evacuation for the area of the Island of Dordrecht. The following topics were selected by the attendees for further analysis:

- Evacuation of people in the areas unprotected by flood defences to the areas protected by flood defences;
- Evacuation of people in the areas protected by flood defences to areas outside the island.

Table 4.1 Typical workshop agenda

Time	Item
10:00	Welcome, introduction and scene setting The objectives of this workshop are: • To present an overview of the project and the draft framework • To gain feedback on the framework and possible ways forward • To provide the basis for discussion on emergency planning issues that might lead to potential actions to tackle some of the identified issues
	Background to FIM-FRAME project in general and the framework *Presentation*
	Breakout 1: Appraise. Identify an aspect(s) of the plan on which to concentrate during the workshop *Breakout session*
11:00	Coffee break
	Breakout 2. Tackle, part 1. Describing the identified aspect of the plan (entity diagram) *Breakout session*
	Breakout 3. Tackle, part 2. Identify potential issues (cross table) *Breakout session*
12:30	Lunch
	Enabling guidance and technology to aid emergency planning in UK and Worldwide *Presentation*
	Breakout 4. Tackle, part 3. Identify potential resolving actions: envisaged barriers, use of specific tools and other implementation issues. (action table) *Breakout session*
	Breakout 5. Implement. Drafting a possible implementation plan.(implementation table) *Breakout followed by plenary discussion*
14:15	Coffee break
	Feedback on the framework: identification of 3 good and 3 bad points of the framework and discussion *Individual work followed by plenary discussion*
	Conclusion and next steps Wrap up of the day and presentation of the next steps of the project
15:00	Close

However, the attendees chose not to consider the topic of shelters e.g. the identification of possible shelters within existing locations or the identification of a few large central shelters.

4.3 Breakout sessions and outcomes

Following the selection of the metrics FIM FRAME method was completed via applying the entity diagram and the cross table. The stakeholders experienced some difficulty in applying the entity diagrams. This is discussed later in this report. The final step in the process was to identify the problems that required be to solve in emergency planning regarding the elected metric and the actions and tools to implement to make those improvement. As part of the FIM FRAME method these issues are dealt with as 'Red Lights'. Attendees were asked to report them in the first column of the "Red Light"\Action table. The attendees were asked to note the "red light" issues that were identified from the cross table onto the action table. The action table was discussed; however, owing to a lack of time not developed further in all the countries. However, there was sufficient time to agree with the stakeholders on what tools were possible to implement to improve the emergency plans that were assessed.

4.4 Gaps identified in the flood emergency plans via the FIM FRAME method

At the conclusion of the workshops, gaps where identified in general in plenary session taking in account the "Red Lights" and action table. The discussion with facilitators brought out the possibility of implementing some tools to fill those gaps. Table 4.2 sums up the gaps identified and the tools proposed as a response in the three countries. Numerous gaps in the plans were identified. Table 4.2 illustrates the main gaps and their associated actions that were identified as part of the workshops.

Table 4.2 Typical workshop agenda

Case study	Gaps identified	Actions and tools to implement
Sheffield	• Gaps in the evacuation process • Dissemination of evacuation message (media, web, door-knocking, signage…) • Places to go (safe havens) and routes to take in case of evacuation	Models addressing evacuation
Dordrecht	• Availability of evacuation routes • Information on demographic numbers; vulnerable groups and to evacuate people • Location of vulnerable people	To test an alternative strategy of sheltering and evacuation using the Evacuaid and RiskTool.
Tarascon	• Lack of flood hazard maps for high frequency floods (3% to 10 % probability floods i.e. discharge < 10500 m^3/s) • Lack of knowledge of potential impacts of extreme events (0.1% floods)	- LIDAR –topographic data - Flood Risk to People model

5 Feedback on the FIM FRAME method and improvements

The chapter deals with how the FIM FRAME method could be improved following the workshops. Improvements to the FIM FRAME method were based on the comments of the attendees collected in plenary session of the workshops and also through a questionnaire distributed to the stakeholders at each workshop. The goal was to help the research team have anonymous feedback on the method developed during the project in order to improve it and to publish a well-tested method in the guidance document.

5.1 Reaction of the attendees to the FIM FRAME framework

The stakeholders who attended the workshops in all three countries indicated that the FIM FRAME method responds to their needs to have a method to assist them to develop new and assess existing emergency plans for floods. The FIM FRAME method provides a method to audit and review plans in an “objective” way. The FIM FRAME method has been applied in different contexts for different types of floods (e.g. coastal, fluvial, flash floods and dam breaks).

The FIM FRAME method was seen by the participants as logical and complete. It ensures that there are no “gaps or omissions between organisations“. In general, there was insufficient time to fully applied the method during a one day workshop e.g. to fill completely the action table and the implementation table. Nevertheless the facilitators intended to focus and developed the implementation on some actions related to the metrics. The following points summarises the findings of the works:

(i) Metrics

The metrics were seen as a good instrument to assess flood emergency plans objectively. In addition the attendees noted that the metrics could be used as a checklist to assess the completeness of the plans. The list of metric has been disseminated through a paper (Lumbroso et al, 2011) and via a number of workshops and conferences. Organisations such as the police and fire brigade who are in charge with emergency planning in the three countries asked for a list of the metrics The list has been disseminated to help organisations evaluate local emergency plans. The list of metrics can be adapted according to the plan that is being evaluated and the local situation. An attendee at the Dordrecht workshop suggests that each country should have an agreement on a list of the metrics to be considered for evaluating and developing flood emergency plans.

(ii) Entity diagrams

The entity diagram proved to be a useful tool to brainstorm and to conceptualization ideas. The entity diagram provides a very “visual“ representation that the stakeholders found useful. However, some attendees preferred the cross-table owing to the “spaghetti” design of the entity diagram. Some stakeholders pointed out the entity diagram appeared to be rather academic. It also was noted in the three countries that this step was time-consuming. A familiarity with the development of the entity diagram means that after applying it several times process becomes more efficient. It is found that it was important to explain and to illustrate the entity diagram with examples and cases studies showing how to construct it.

(iii) Cross tables

The cross-table gave a good overview of issues and provided a method to further develop a topic. The cross-table brings out a collective vision and facilitates the translation of the entity diagram into processes, “potential errors” and eventually gaps. The cross-table is an important step to convert the process to assess the gaps in a plan. The participants at the workshops found this step easier to implement and to understand than entity diagram.

5.2 Facilitators feedback on the application of the FIM FRAME method

The facilitators noted that the framework had been welcomed and quickly appropriated by the stakeholders who attended the workshops. It was interesting to note that the attendees at the workshops did not contest the scoring of the plans, assuming that there was a real need for updating or enhancing them. The following issues were noted by the facilitators of the workshop.

(i) The choice of metric to discuss

Facilitators noted that is important to orientate the discussion and the choice of the metrics to assess during the workshops. There was a question related to the degree of freedom the facilitators let the discussion follow. Generally it was agreed that it was important to discuss the metrics with the lowest scores in order to establish how the emergency plans could be improved.

(ii) The use of the FIM FRAME method to develop a new emergency plan for floods

The framework was used to assess existing flood emergency plans. The workshops held in the three countries did not apply the framework to develop a new plan. It is therefore recommended that in future when stakeholders are developing a new emergency plan for floods that they apply the FIM FRAME method.

(iii) The duration of the workshops required to apply the FIM FRAME framework

The objective and the strength of the framework are to identify shortcomings within an emergency plan which can be tackled with use of available tools and information. In the workshop, the framework provided an excellent method to identify these shortcomings. However, it does take some skill and time to identify these gaps. It is important to encourage the participants to think “out-of-the-box” and in terms of “the ideal situation”. This tendency of the stakeholders can be summarised by the following sentence find in an attendees questionnaire in England: *“It is something that can be adopted by those new to the field in the development of new plans or within the first review they do, but those who have been doing this for a while usually know where their gaps are”.* Facilitators noted that in Netherlands and France owing to a lack of time, it was sometimes difficult to implement the “implement” stage. The action table takes time to implement as there are many issues to address and actions to tackle. It thus could be recommended to separate the workshops into two days in order to dedicate one day to assessing the plan and one to identifying the gaps and one day to establishing solutions and to drawing up an implementation plan of measures to enhance the plan.

(iv) Focusing on the flood emergency plan

Facilitators noted that it was easier for attendees to refer to an particular situations that they were familiar with. Stakeholders tended to focus and assess details that they were familiar with rather than concentrating on the plan itself. It is important that the facilitators of the workshop focus the discussion on the plan.

5.3 Differences between the three countries

The FIM FRAME method was implemented successfully in the England, France and the Netherlands there were some difference in how the method was applied. Those differences are summarised below.

(i) List of metrics

The list of the metrics needs to be adapted to the particular needs of each country. For instance, in the Netherlands the metric “details of previous floods“ was not seen as being relevant because the country is well defended and there have been no significant floods in the country since 1953. For the Dutch evacuation was a key question and may merit more than two metrics. An attendee in Dutch Workshop suggested that in each country there is an agreement on the list of metrics to be adopted for developing and assessing emergency plans for floods.

(ii) Type of flood

In the three countries the FIM FRAME method was piloted in areas where there are a wide range of different floods i.e. fluvial, coastal, flash, surface water and dam break. It was found that the FIM FRAME method was not limited by the type of flood.

(iii) Involvement of national level stakeholders

In both France and in Netherlands there was a lack of involvement in the research by the relevant national level organisations. In England and Wales the Environment Agency appeared to be more engaged with the development of the method. The reasons for this are partly to do with the spatial scale at which the plans are applied in the three countries and the institutional/organisational set up. In all three countries local authorities are generally responsible for the development of emergency plans for floods. The following is often the case with these organisations:

- They often have no financial means to implement tools to improve emergency plans
- There is some times political oppositions to the dissemination of the outcomes of tools (e.g. such as potential loss of life, risks to buildings)

(iv) Spatial scale of emergency plans

In France there are approximately 36,700 communes of which some 10,000 have to produce emergency plans to cover the natural hazards that occur in their communes. In France the lack of an overview of the regional flood risk can be problematic for developing an effective emergency plan. For example in France the flooding of the Rhone valley would hit more than 30 communes. However, there is no coordination of the crisis management at the upper level of the low Rhone valley. The spatial extent of emergency plans in France means that it may be better apply the FIM FRAME method at a river basin scale by producing one emergency plan for an agglomeration of communes.

(v) Workshop participants

The participants at the FIM FRAME workshop determined, to a certain degree, the success of the application of the FIM FRAME method. In England and the Netherlands, the people who attended the workshops were professionals and specialists with a strong involvement in flood emergency management. In France the workshops brought together specialists and policy makers local authority staff whose core competencies are not in emergency planning and who are mobilised only in case of crisis. For participants such as mayors or authorities, flood emergency planning is just one problem amongst many others. In France it was felt that the FIM FRAME method would be best used by the fire service who are the main point of contact for the technical aspects of emergencies and .

In Netherlands, people who attended the two workshops were emergency management professionals. They worked for the police, fire department and municipality and are representatives for their organisation within the Safety Region. They were involved in the development of the flood emergency management plan for their region. That explains why the level of technical discussion and the comprehension of the framework seemed to be higher in Netherlands than in France.

(vi) The application of tools

The flooding is a national concern in the Netherlands especially ongoing sea level rise. Many of the tools that were investigated as part of the research are very useful for the project. In France, the application of the FIM FRAME method to local emergency plans was found to be useful as as the plans assessed (i.e. the Plans Communaux de Sauvegarde (PCSs)) are a relatively new legal requirement. However, PCSs are in general multi-risk plans looking at a range of hazards. In this respect there are some tools that were found to be more useful than others.

5.4 Improvements to the FIM FRAME method

The stakeholders who attended the workshop and the facilitators recommended improving the framework as follows:

- To define the level of detail of the discussion in advance of any workshop
- To list the processes linked to the chosen metric analysed at the workshop in advance of the workshop.
- To make the entity diagrams more simple and more efficient
- To use actual case studies and concrete examples in the workshop
- To put more emphasis on “improving” flood emergency management plans through the better use of available tools and information
- To distinguish between and making the step from “analysing an actual crisis situation” to “defining what needs to be done to improve the plan”.

6 Conclusions

This report describes the implementation of the FIM FRAME Method in the case studies in England, France and the Netherlands. In total seven workshops were held three in England, two in the Netherlands and two in France between July 2010 and April 2011. The application of the FIM FRAME method and is described in the guidance document that has been produced as part of this research.

The workshops in the three countries showed that there was a demand for simple method to appraise and improve emergency plans as well as to develop new plans. The main conclusions reached by the case studies were as follows:

- There is a demand amongst emergency planners for a simple method to assess existing flood emergency plans as the number of such plans is
- The FIM FRAME method was found by the attendees of the workshops to be a good method to assess their emergency plans.
- The FIM FRAME method helps to facilitate discussions between stakeholders, policy makers and emergency planners. It can bring out both existing problems as well as those that are sometimes ignored
- The workshops allowed gaps in plans to be identified and tools that could help “fill” these the gaps to be identified

The list of the metrics was found to be a good “checklist” with which to assess emergency plans for floods. This list has already been disseminated through papers and applied in a number of other case studies. The workshops often lasted a whole day (i.e. between six and eight hours) in order to complete all the steps contained in the FIM FRAME method.

Problems associated with the implementation of the FIM FRAME method were identified and addressed via the workshops. Issues with the FIM FRAME method were found to be the following:

- Definition of the aim of the method at the workshops - It was found that it was important to explain fully the method before commencing the workshop
- The discussion needed to be adapted depending on the type of stakeholders who attended the workshops
- There was often found to be insufficient time to complete the last steps of the FIM FRAME method (i.e. the implementation table and potential actions)

The FIM FRAME method was applied successfully to different kinds of floods (e.g. dams and dike failures, fluvial flooding, surface water flooding and flash floods) and different kinds of plans (i.e. local and regional level plans) In terms of future work it would be interesting to address the following questions:

- How can the FIM FRAME method be adapted so that it can be applied to multi-risk plans and or to other types of risk (e.g. natural or technological hazards)?
- The possibility of developing a more concise and simpler version of the FIM FRAME method for use by small local authorities covering relatively small areas where resources are limited.

The final aim of the FIM FRAME method is to identify the gaps in emergency plans and to provide stakeholders methods via which the gaps can be filled by using tools (e.g. checklists, guidance documents, technical method and software). In all three countries the outputs of the tools were welcomed by the emergency planners and the research showed that they matched to existing needs. The case studies also allowed extreme scenarios that had never been looked at to be considered in terms of the emergency plan. Tools to estimate the risks to people posed by floods have been used in the three countries either to test directly the potential consequences of different scenarios in terms of mortality rates or to test the effectiveness of different evacuation strategies.

It was found that there were some differences between the three countries. The implementation of the FIM FRAME method and tools should take into account the cultural and political features of each country. For example in some case studies ther was some reluctance to disseminate the results of some of the modelling of flood impacts unless emergency planners and policy makers agreed with the outputs of the models. It was noted that policy makers often hesitate to publish the results of the application of tools as this can trigger questions or cause anxiety amongst the population at risk. The dissemination of potential loss of life caused by extreme flood events can worry authorities because it can raise questions such as: What can we do? And how can the search and rescue practices be improved?

References

Binder Denis (2005) – Emergency actions plans: a legal and practical blueprint – University of Pittsburgh Law Review, Vol. 63, p. 791
CETMEF (2004) – Description des ruptures de digues consécutives aux crues de décembres 2003, dans les départements des Bouches-du-Rhône, du Gard et de l'Hérault – 43p.
CIRE Sud, ARS PACA (2010) – Le point épidémio, Veille Hebdo Provence Alpes Côte d'Azur – Corse, Point n°2010-25 publié le 25 juin 2010, 13 p.
CNR (2004) – Décembre 2003, une crue historique – dossier d'information, 42p.
CNR (2004) – La crue du Rhône de décembre 2003. Synthèse hydrologique – 36p.
Cova, T.J. (1999) – GIS in emergency management – In : Geographical Information Systems: Principles, Techniques, Applications, and Management, P.A. Longley, M.F. Goodchild, D.J. Maguire, D.W. Rhind (eds.), John Wiley & Sons, New York, pp. 845-858 : http://www.geog.utah.edu/faculty/index.html?id=1
Dantzig G.B. (1999) – Planning under uncertainty – Annals of Operations Research, Volume 85, Number 1
Di Mauro M. (2009) – Testing of mortality functions, application to the 1953 Canvey Island flood – 28 pages
Di Mauro M., Lumbroso D. (2008) – Hydrodynamic and loss of life modelling for the 1953 Canvey Island flood – In Samuels P., Huntington S., Allsop W. and Harrop J.,
DIREN de Bassin/ DIREN Languedoc Roussillon (2004) – Inondations du Rhône et de ses principaux affluents de décembre 2003 en aval de Viviers dans les départements de la Drôme, de l'Ardèche, du Gard, du Vaucluse et des bouches-du- Rhône – 62p.
Dugrand R. (1953) – L'aménagement du bas Rhône – In: Annales de Géographie. 1953, t. 62, n°333. pp. 368-373.
EPTB Rhône, CNR (1999-2003) – Etude Globale Rhône.
Gralepois M. (2008) – Le Plan Communal de Sauvegarde. Une approche territoriale de la sécurité civile à travers l'enquête des conditions de mises en place dans les communes françaises – Conseil National de la Protection Civile. 68p.
Gruntfest E, Handmer J (eds) (2001) – Coping with flash floods. – NATO science series, Kluwer Academic Publishers
Heiderich D. (2010) – Plan de gestion de crise – Dunod, Paris. 240p
Hoss, F., Horst, W. ter, Jonkman, B., Maaskant, B. (2011) Multilayer safety strategies in Dordrecht, Analysis of risk of life. Delft University of Technology, Faculty of Civil Engineering and geosciences
HR Wallingford and Middlesex University Flood Hazard Research Centre (2006) Flood Risks to People Phase II. Flood and Coastal Defence R&D Programme
Jonkman S.N. (2004) – Method for assessing the loss of life as a result of large scale flood, in Dutch - Report 2004-042
Jonkman S.N. (2005) – Global perspective of loss of human life caused by floods – Nat Hazards, 34: 151-175
Jonkman S.N. (2007) – Loss of life estimation in flood risk assessment: Theory and Applications – PHD thesis, 354 p.
Jonkman S.N. et al (2009) – Loss of life caused by the flooding of New Orleans after hurricane Katrina: Analysis of the relationship between flood characteristics and mortality – Risk analysis, Vol. 29, N5
Jonkman S.N., Kelman I. (2005) – An analysis of causes and circumstances of flood disaster deaths – Disasters, 29(1): 75-97
Johnstone, W. M., Alexander, D., Underwood, D. and Clark, J. (2006) LSM System V1.0: Guidelines, Procedures and Calibration Manual. BC Hydro Engineering
Klijn, F., Baan, P., Bruijn, K., Kwadijk, J. (2007) Overstromingsrisico's in Nederland in een veranderend klimaat, verwachtingen, schattingen en berekeningen voor het project Nederland Later. In opdracht van Milieu- en Natuurplanbureau (MNP); rapport: WL | Delft Hydraulics; Q4290
Kolen, B., Maaskant, B., Thonus, B. (2010) Effecten van evacuaties-strategien in beeld gebracht; 2010; H2O – 22

Leclère J-R (2010) – The improvement of flood emergency plans in Europe as part of the FIM FRAME project: stakeholders of analysis and loss of life modeling – Internship master degree report-129p.
Leveau P. (1999) – L'hydrologie du Rhône, les aménagements du chenal et la gestion territoriale de ses plaines en aval d'Orange – In: Gallia. Tome 56. pp. 99-108.
Lumbroso D.M. and Vinet F. (2011) A comparison of the causes, effects and aftermaths of the coastal flooding of England in 1953 and France in 2010 NHESS. (accepted).
Mairie de Tarascon (2010) – DICRIM
Mairie de Tarascon (2011) – Plan communal de sauvegarde
Mak J. (2008) – Modelling the evacuation process in case of flooding – FLOODsite, 58 p.
Maaskant, B., Kolen, B., Jongejan, R., Jonkman, S.N., Kok, M.(2009) Evacuatieschattingen Nederland, HKV lijn in water. Lelystad; PR1718.10
MEDDLT (2010a) – Tempête Xynthia. Retour d'expérience, évaluation et propositions d'action – Rapport du gouvernement français, mai 2010, 2 Tomes.
MEDDLT (2010b) – Retour d'expérience des inondations survenues dans le département du Var les 15 et 16 juin 2010. – Rapport de mission d'expertise pour le compte du ministère de l'écologie français. Octobre 2010, 87 pages.
MEEDAT (2008) – Expertise du schéma de protection dans le secteur de Tarascon-Arles – 79p.
Méjean A. (2007) – Etudes historiques des aménagements réalisés contre le risque inondation dans le « Grand Delta » du Rhône – Université Paul Valéry. 111p.
Météo France (2004) – Fortes précipitations de décembre 2003 et conséquences sur les bassins du Rhône – Etude pour la CNR, 20p.
Ministère de l'Intérieur (2005) – Plan Communal de Sauvegarde, Guide pratique d'élaboration – 176 p.
Ministère de l'Intérieur, de l'Outre Mer, des Collectivités Territoriales et de l'Immigration (2010) – PCS : Bilan 2010 et bonnes pratiques à l'usage des préfectures de département. 28p.
Pardé M. (1919) – Le régime du Rhône à Beaucaire – In: Recueil des travaux de l'institut de géographie alpine. Tome 7 N°2. pp. 309-368.
Proceeding of the Floodrisk 2008 Conference, Taylor and Francis group, London
Provansal M., Arnaud-Fasseta G., Vella C. (2004) – Géomorphologie du Delta du Rhône – In : Bulletin archéologique de Provence, Editions de l'APA, pp 59-63.
Ramsbottom et al (2005) – R&D outputs: Flood Risks to People, the Risk to People Methodology - in Flood and Coastal Defence R&D Programme, DEFRA/Environment Agency, 92 p.
Robert-Bobée I. (2007) – Projections de population 2005-2050. Vieillissement de la population en France métropolitaine – économie et statistique, INSEE, N° 408-409, pp 95-112.
Six C, Mantey K, Franke F, Pascal L, Malfait P (2008) – Etude des conséquences psychologiques des inondations à partir des bases de données de l'Assurance maladie. – Institut de veille sanitaire, Saint Maurice (Fra)
SYMADREM (2010) – Version définitive du rapport final complet des études de modélisation des crues avec et sans brèches – 110p.
Thonus, B.; RisicoTool 2.1, Gebruikershandleiding (2008) HKV Lijn in Water; PR1330.20
Veiligheidsregio Zuid-Holland Zuid; Regionaal basisplan overstromingen Zuid-Holland Zuid, Algemeen deel, versie RBO ZHZ v.2.8; 2008
Veiligheidsregio Zuid-Holland Zuid; Regionaal basisplan overstromingen Zuid-Holland Zuid, Specifiek deel dijkring 22, Eiland van Dordrecht,
Versini P.A, Gaume E., Andrieu H. (2010) – Assessment of the susceptibility of roads to flooding based on geographical information – test in a flash flood prone area (the Gard region, France) – In : http://www.nat-hazards-earth-syst-sci.net/10/793/2010/nhess-10-793-2010.html
Vinet F. (2010) – Le risque inondation. Diagnostic et gestion – Lavoisier, Paris.314 p
Wilson T (2006) – Les risques de blessures et de décès par imprudence lors des inondations. – In Responsabilité et environnement, 43, pp 57-63

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CRUE
FLOODING ERA-NET

Integrate, Consolidate and Disseminate
European Flood Risk Management Research

2nd ERA-NET CRUE Research Funding Initiative
Flood Resilient Communities – Managing the Consequences of Flooding
Final Report

ANNEX D TO THE FIM FRAME FINAL REPORT

IMPROVING AND ASSESSING EMERGENCY PLANS FOR FLOODS - THE FIM FRAME METHOD

GUIDANCE DOCUMENT

DRAFT FOR CONSULTATION

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DISCLAIMER

Second Era-Net CRUE Funding Initiative: Flood resilient communities – managing the consequences of flooding

CRUE Research Report

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The second ERA-Net CRUE Research Funding Initiative **"Flood Resilient Communities – Managing the Consequences of Flooding"** was launched in support of the EU Floods Directive 2007/60/EC, which was introduced as a result of several severe flood events causing loss of life and property. Within this initiative seven joint research projects with test sites all over Europe are funded and focus on a broad spectrum of issues related to the enhancement of resilience. Besides, the scientific coordination project CORE CRUE is funded within this second call, to support the implement of the call and to disseminate its results.

Flood Incident Management – A FRAMEwork for improvement – FIM FRAME

CRUE Research Final Report

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Contents

1 Introduction

Recent decades have seen significant increases in the number, scope and complexity of incidents and disasters. It is now generally agreed that places that are significantly at risk of hazards should be required to construct emergency plans. Recent research has found that there is an “enormous variety and lack of homogeneity” amongst emergency planning documents in many parts of the world. There is a shortage of adequate methods for creating, evaluating and approving emergency plans. Many emergency planners have expressed a need for guidance as they are often uncertain about the quality and appropriateness of their plans, and on how to develop new plans.

This document provides guidance on a method for developing or improving an emergency plan for floods. The method was developed within the ERA-Net CRUE FIM FRAME project and is known as the FIM FRAME method. The method is designed to be:

- **Simple**, so that it can be applied by anyone without any specific training
- **Transportable**, so that it can be used anywhere
- **Generic**, to allow it to be adapted by users for their specific purpose and not limited to a specific spatial scale (i.e. the method can be used at a local, regional and national level)

In conjunction with the FIM FRAME method suggestions are made of tools that can be used by emergency planners, flood risk managers and emergency responders to develop and improve emergency plans. In the context of the FIM FRAME method the term “tool” is used to refer guidance documents, checklist, a specific method or software.

The five principles of information management were used to develop the method. The five principles of information management take the form of a set of statements or objectives for information management. These are:

- **Data and information** - Recognise and understand all types of information, incoming and outgoing;
- **Roles and responsibilities** - Understand the legal issues and execute “duty of care” responsibilities, including stakeholder engagement;
- **Processes and procedures** - Identify and specify processes and procedures undertaken, whether technical or organisation orientated;
- **Tools and technologies** - Identify tools (e.g. databases, modelling software, checklists, decision trees, flow diagrams) and enabling technologies (e.g. the internet, video, publishing) to support the processes and procedures;
- **Audit and control** - Monitor and audit the processes and procedures and carry out remedial actions as required, i.e. do the actual activities undertaken match with the desired activities, if not what needs changing – the actual activities or the desired activities?

These principles can be applied to all information flow systems, such as that involved in managing a flooding response, and bring together all possible elements everything from high-level policy issues to detailed analysis. This type of framework enables all of the actors and actions involved in a system to be mapped, and thereby to develop comprehensive and optimal procedures. The five principles are shown in Figure 1.1.

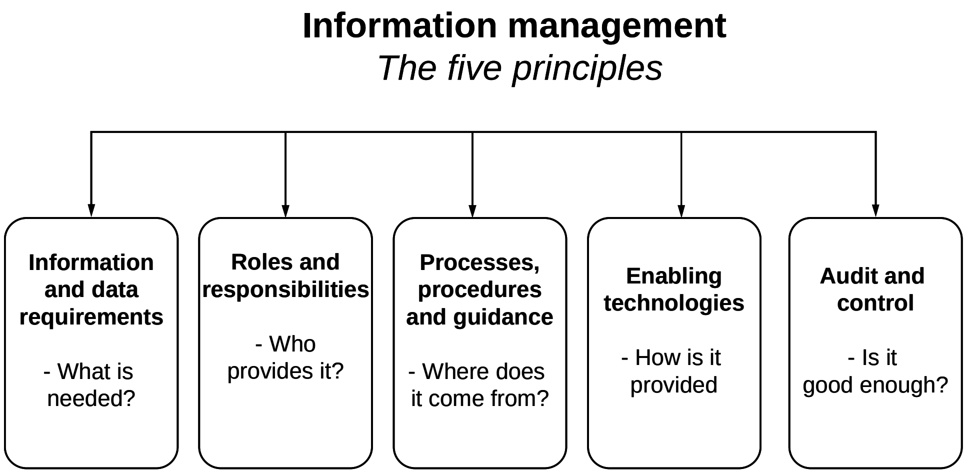


Figure 1.1 The five principles of information management

(i) Information and data requirements

Fundamentally, any organisation involved with the emergency planning for floods must review their information and data requirements to ensure they match their needs. It is not sufficient to assume that because certain information or data are collected or generated they will always be needed. Information demands need to be expressed explicitly to all the stakeholders involved. The movement of information through the emergency response system, between responders and with the public, needs to be understood.

(ii) Roles and responsibilities

It is important to define the roles and responsibilities of stakeholders involved in the emergency planning for floods. This can then be mapped to their data requirements, and how they change and transmit information.

(iii) Processes, procedures and guidance

The processes, procedures and guidance for emergency planning for floods within each organisation will be described at this stage. This means that if an organisation is a collector of information used in emergency planning, it needs to be stated what techniques are used. Similarly, if an organisation generates data using modelling (e.g. flood forecasts) such procedures also need to be documented.

(iv) Enabling technologies

In order for organisations to improve their emergency planning for flood events it is important that they apply appropriate enabling technologies. This does not mean the organisation has to constantly keep up with the latest technological developments, but it should recognise that technology does become obsolete and thus it is important to make informed decisions about upgrade programmes.

(v) Audit and control

The audit and control stage is an essential part of any practices for maximising the value of information. It enables the benefits of the process to be quantified and areas of improvement identified. If the organisation already has a formal audit procedure, then procedures to improve information exchange should be incorporated within it.

Information provision is an essential component of emergency management and therefore effective information management is an important component of effective emergency planning. Whether data is used in a commercial or non-commercial environment it is essential that the costs of providing the data are less than the benefits obtained. However, the value of data can easily be misunderstood if there is no agreed basis for discussing and organising an organisation's ideas about it. This subject has to be dealt with in a practical and effective way which will allow possible solutions to be implemented in those cases where there is any advantage to be gained.

This guidance document has been structured as follows:

- Section 2 provides a theoretical overview of the FIM FRAME method
- Section 3 provides some practical examples of implementing the method in England, France and the Netherlands
- Section 4 provides brief details of some of the tools that are available that are applicable to helping develop and improving emergency plans for floods

2 Use of the FIM FRAME method to develop and improve emergency plans

2.1 How to apply the method

The method is structured in three steps:

1. **Appraise** - Applying metrics to assess plans in order to 'flag up' general issues
2. **Tackle** - structuring\de-structuring the process and identifying specific issues
3. **Implement** - taking actions to address the issues and updating the plan

These steps are shown in Figure 2.1 These steps do not need to be applied sequentially and the method can be used starting at any point. For example, if no plan is in place the method can be applied starting from step 2. If some issues have already been identified e.g. as result of a post-event appraisal or an exercise, then the starting point could be step 3. The FIM FRAME can also be used as a process of continually improvement e.g. to re-appraise a plan after it last been updated.

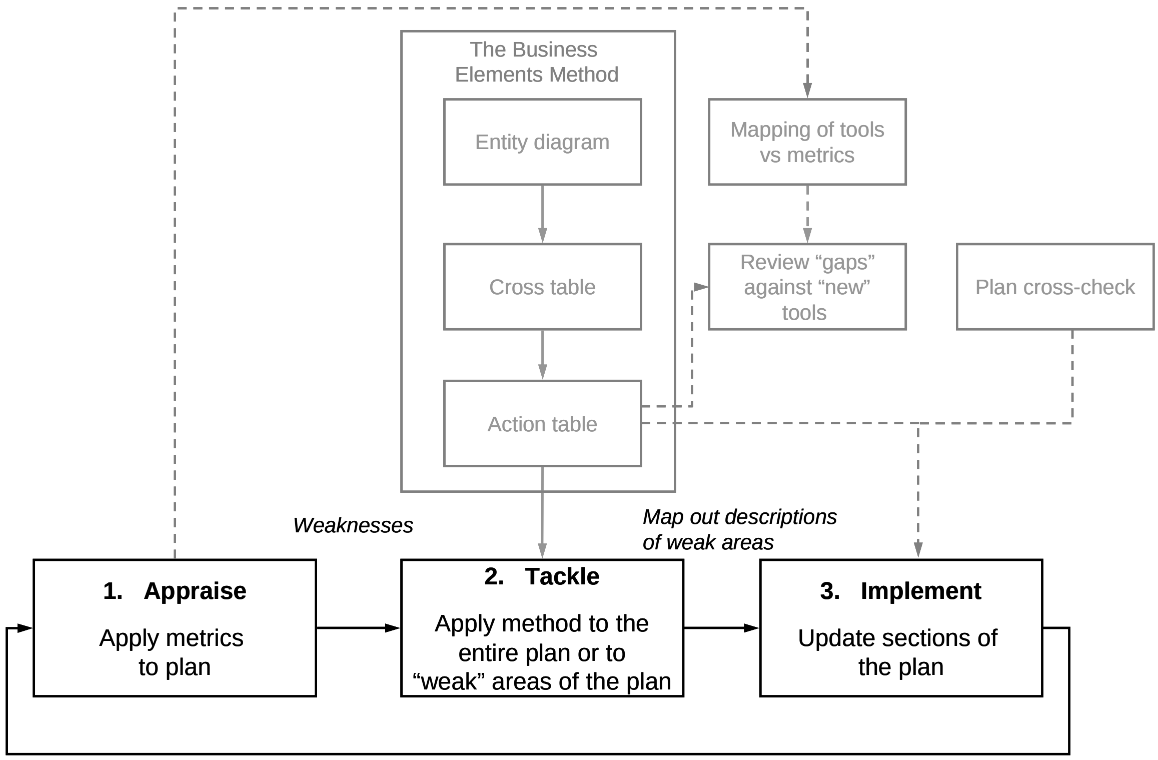


Figure 2.1 **Diagram of the FIM FRAME method**

In setting out the above method, there is one element that requires further explanation. Step 2 requires the application of the Business Elements Method, which is an approach for analysing any business process.

The Business Elements Method is a tried and tested approach for analysing any process (or event); in this case the flood emergency plan. This method consists in examining the process in terms of five factors:

- Processes
- Roles and responsibilities
- Data and information
- Tools
- Audit

Considering these elements can help to produce a clearer picture of the process and provide an understanding of the interdependencies within the different parts that constitute the process. This can help to identify, possible issues or "weaknesses", and to gain a clear understanding of how to address these and how these can affect the process.

2.2 Step 1 -"Appraise" - Apply metrics to identify general issues or weaknesses

In order to appraise an emergency plan for floods 22 metrics were developed. The set of metrics developed can be:

- Applied to emergency plans for floods at a range of geographical scales ranging from a regional to local level
- Generic but at the same time be clear and focused to avoid misinterpretation
- Measurable

The metrics used to appraise a plan are given in Table 2.1. The metrics allow for the plans to be "scored" in a quantitative manner. For example a score of "1" would be given for a metric where the level of detail is low"; "2" where the level of detail is medium and "3" where the metric is treated in a high level of detail. By averaging the metric scores, an overall score of a plan can be obtained. In addition the average score per metric for the evaluated plans gives an insight into which metrics are addressed within the plans and to what level of detail. The average scoring range for the developed metrics was divided into five equally distributed bands between a score of 1 and 3. These scoring bands are given in Table 2.2.

It is important to note that if a metric is not covered in an emergency plan for a flood but is included and covered in sufficient detail in a clearly referenced, complementary plan then the metric should score a "3" (i.e. a high level of detail). For example in the case of the metric for "evacuation routes" if these are clearly shown in a generic evacuation plan that covers a wide range of hazards and this evacuation plan is clearly referenced in the emergency plan for floods then the "Evacuation routes" metric should score a "3".

The appraisal of the plan consists of assessing the plan against the metrics developed. This appraisal achieves an initial understanding on how the plan is likely to perform and what are the main weaknesses.

Table 2.1 Metrics for the appraisal of emergency plans for floods – Part 1

Metric	Level of detail		
	Low	Medium	High
Objectives, assumptions and target audience			
Aims and objectives of plan	Not detailed	Aims and objectives included but could be clarified further	Clearly stated aims and objectives including the area covered, types and sources of flooding
Target audience and updating of the plan	Not detailed	Audience defined and plan dated	Audience defined and how they will be notified of updates and modifications to the plan included
Assumptions made by the plan	Not detailed	Covers some aspects	Covers all aspects including: flood warning lead time; method by which rescue will be undertaken; implications of the failure of critical infrastructure
Organisation and responsibilities			
Actions, roles and responsibilities	Not detailed	Brief details of the roles and responsibilities related to the activation of the plan provided	Details of the roles and responsibilities related to the activation of the plan provided including health and safety and environmental considerations
Recovery	Not detailed	Brief details of how the recovery is managed	Details of how the recovery is managed including clean up, waste disposal, repairs to public assets, humanitarian assistance
Training and exercises	Not detailed	Brief details of training and exercise requirements	Internal and external (with other organisations) training and exercises outlined
Plan activation	Not detailed	Brief description of the thresholds or levels used to activate plan	Description of the thresholds or levels used to activate plan together with flow chart
Communication			
Communication with other agencies	Not detailed	Outlined in words	Detailed and the links shown diagrammatically
Communication with the public	Not detailed	Outlined in words	Detailed and shown the links shown diagrammatically
Management of the media	Not detailed	Outline media management strategy in place	Well defined media management strategy in place
Flood warning (if available)	Undefined	Levels of flood warning with details of the areas flooded at each level	Levels of flood warning with details of the areas flooded at each level and shown on a map
Relationship with complementary emergency plans detailed	Not detailed	Outlined in words	Detailed and the links shown diagrammatically

Table 2.1 Metrics for the assessment of emergency plans for floods – Part 2

Metric	Level of detail		
	Low	Medium	High
Evacuation			
Evacuation routes	Not detailed	Evacuation routes shown on a map	Evacuation routes detailed together with roads likely to be closed and their accessibility for emergency vehicles and other vehicles
Shelters/Safe havens	Not detailed	Safe havens/shelters shown on a map	Safe havens/shelters shown on a map with their capacity and facilities
Flood hazard			
Flood hazard map	Not detailed	Flood hazard map(s) showing extent	Flood hazard map(s) showing water depth and velocity
Details of previous floods (if available)	Not detailed	Brief description of historical flood	Description of historical floods with the cause and a brief description of the risk in terms of people and properties affected
Flood risk to receptors			
Flood risk to people	Not detailed	Number of people potentially affected included	Potential injuries and loss of life included and mapped for a range of scenarios
Flood risk to vulnerable people (e.g. elderly or disabled)	Not detailed	Areas where elderly/sick people live mapped	Numbers of vulnerable people defined with a response strategy
Flood risk to residential property	Not detailed	Number of properties defined	Number of properties defined together with those at risk of collapsing during an extreme flood
Flood risk to businesses	Not detailed	Number of businesses defined	Number and type of businesses defined together with potential losses
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	Not detailed	Number of pieces of critical infrastructure shown on the flood map(s)	Number of pieces critical infrastructure shown on the flood map(s) and an assessment of their likelihood of failure during a flood
Potential for NaTech hazards at industrial facilities (if present)*	Not detailed	Potential NaTech sites shown on map	Potential NaTech sites shown on map and brief details of the response

*Note: A NaTech is defined as technological hazard that is triggered by a natural hazard. For example the flooding of an industrial plant may lead to the release of a toxic chemical that poses a threat to humans, as well as flora and fauna

Table 2.2 Scores for the emergency plan

Average score	Average quality	Description to determine the quality of the flood emergency management plan
2.6 to 3.0	Good	There is little or no further information that could have been included in the plan. This can be considered as a 'Good' score with little room for improvement.
2.2 to <2.6	Above average	There is some further information that could have been included in the plan. This could be considered an "Above average" score.
1.8 to <2.2	Average	Considerably more information could have been included in the plan. This could be considered an "Average" score.
1.4 to <1.8	Room for improvement	There is information missing from the plan. There is "Room for improvement".
1.0 to <1.4	Considerable room for improvement	There is a large amount of additional information that could be included in the plan. There is "Considerable room for improvement".

2.3 Step 2 - "Tackle" - structuring\de-structuring the process and identifying specific issues

This step can be performed for the whole plan or just for particular aspects, (e.g. for metrics that obtained a low score in the "Appraise" step). The "Tackle" step aims to go through specific processes (or components of the plan) and expand them into their constituent "items or entities", each of these being analysed both individually and in combination with the other items they are linked to. This analysis is based on the application of the five principles of the Business Elements Method (i.e. processes, roles and responsibilities, data and information, tools and audit) that have been adapted to comprise three subsequent steps:

(i) Describe the process - the **Entity diagram**
(ii) Process\Responsibilities\Tools\Information - the **Cross-table**
(iii) Identify and tackle the issues – the **Action table**

For each of these steps there corresponds a specific outcome: the Entity diagram, the Cross-table and the Action table; the latter will be used as the basis for the implementation and the updating of the plan as part of Step 3 – "Implement".

2.3.1 Part (i) - Entity diagram

The first part consists of developing an entity diagram for the entire plan or for just a particular aspect of the plan (e.g. the identification of vulnerable people). The aim of the entity diagram is to include all the elements that constitute the particular process. This diagram also aims to describe the relationship between such elements. An 'Entity diagram' comprises boxes and arrows.

The boxes contain specific "entities". The entities are the components that constitute the aspect being analysed. The arrows describe the relationship between the entities. For each of the boxes, the following questions should be addressed:

- What does this entity do? (e.g. what is the process and who is responsible for the process)
- What does this entity provide? (e.g. what information is produced)
- Who does it inform? (e.g. who receives the information and who is responsible for passing this information)
- Who makes sure that this is done? (e.g. who audits the process)

- How this is done? (e.g. which tools are used\needed to produce the information or perform the process)

The answers to these questions might already be in a box in the diagram, and therefore an arrow can be drawn to connect the two boxes. Alternatively, another box should be added to identify the missing entity and then connect the existing box with the new one. Figure 2.2 provides a generic example of an entity diagram.

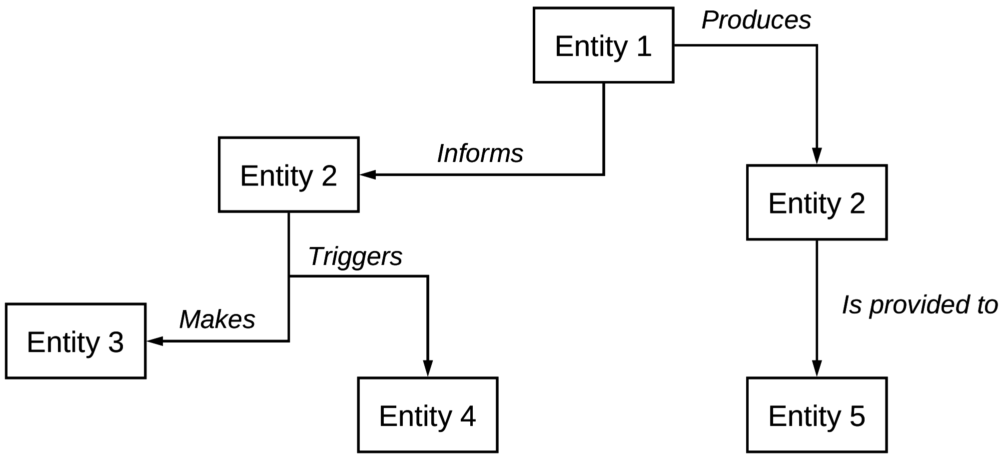


Figure 2.2 Example of a generic entity diagram

2.3.2 Part (ii) - Cross-table - Process\Responsibilities\Tools\Information

The part of the method considers each entity in the diagram. The outcome from part (ii) is a simple table containing all the entities in the first quadrant, the related roles and responsibilities in the second, the Information in the third and the Tools in the fourth quadrant. This is shown in Figure 2.3.

1. Processes and procedures (What ?)	**2. Roles\Responsibilities (Who?)**
4. Tools (How?)	**3. Information (Which data?)**

Figure 2.3 Example of a generic cross table

Starting from one 'quadrant' of the cross table (e.g. Processes and procedures), the first question to ask will be:

Processes and procedures What does the entity do?

Once the process is described, the other part of the tables and the relative links should be completed by exploring:

FROM Processes and procedures TO Roles and responsibilities Who is responsible for doing this? Who checks that this has been done?

FROM Processes and procedures TO Information Which data or information are needed for doing this?

FROM Processes and procedures TO Tools What tools are needed\used for doing this?

Once the links between Processes and procedures have been explored, the other quadrant of the tables should be analysed, starting from e.g. the Information quadrant:

FROM Information TO Roles and responsibilities Who uses this data? Who is responsible for providing this information? Who audits that this information is provided\disseminated?

FROM Information TO Tools How is this information produced? How is it communicated? Where\how is it stored?

FROM Tools TO Roles and responsibilities Who owns the tools? Who has access to the tools?

Figure 2.4 gives an example of a generic cross table that has been completed. Completing the cross table helps to provide a better understanding of the elements of the process as well as of the links within the various elements. While constructing the cross-table, certain issues can arise. These issues should be highlighted and should be discussed in detail in the next part.

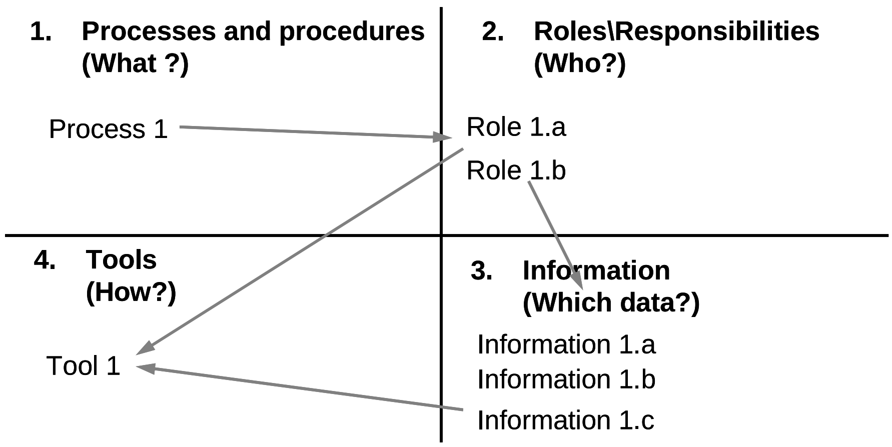


Figure 2.4 Example of a filled in generic cross table

2.3.3 Part (iii) – Action table

When identifying the links in the cross table, certain issues can arise, for example:

- Identifying the links may not be straightforward;
- Some links that should theoretically be in place do not exist in practice;
- Some information is not provided by any entity (e.g. neither by a tool nor a person)
- Information is provided but not fed back to anyone

Once such an issue arises, this should be reported and described in the first column of the Action table. The blank action table is shown in Table 2.3.

Table 2.3 Action table – identifying 'Tackling actions'

Issues	Tackling actions					Implementation			
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed ?	Who checks this is done? Audit	Priority	Resources	Time-line	Plan to be updated?

For each of the identified issues, the user can analyse how to address them by going through the questions proposed by the table, and filling the columns in accordingly:

How to address it? Defining a specific Action(s) that is (are) needed to tackle the issue.

Who should bring it forward? Identifying who should be responsible for taking forward each of the specified actions.

What information is needed? Listing possible information and sources of information

Is any tool needed? Discuss if any particular tool is needed to create the required information, who owns the tool and how this can be used. A table providing some guidance on some of the tools that are currently available is given in Appendix A

Who checks this is done? Assigning a physical person who should be responsible to audit and check whether the action is brought forward as well as whether this is done correctly

Once the issue has been analysed, part (iii) should be repeated for other identified issues. The outcome of this process is the Action Table containing tangible actions that should be undertaken and audits that should be introduced into the process, as well as identifying responsibilities for these actions.

This simple analysis can provide a guide for exploring the process and spot possible issues, especially due to the links within different aspects that might not have been fully covered in emergency plans, and that might cause possible “bottlenecks” to the process.

Listing these items in a table might help to keep track of them, and this can be of help to check whether these have been addressed in the next review of the plan. Table 2.4 provides an example of the analysis of an issue through the Action table

2.4 Step 3 “Implement” - taking actions forward

This step should start from the issues and relative actions identified by the Action table. It can also start from specific issues identified elsewhere, e.g. directly through the appraisal of the metrics or by other means e.g. a post-event assessment. This step should include:

a. Plan cross-check, to identify specific parts of the plans that cover (or should cover) the issue.
b. Update the section of the plans, identifying detailed measures that should be taken to include the specific issue in the plan or to modify the plan so that the specific issue is covered.
c. Reviewing the action list and push forward the implementation plan.

Once the issue is described and the Tackling Actions identified in the Action Table, the Implementation part of the table needs to be filled in. For each of the identified Actions, the following need to should be specified:

Priority	What is the degree of importance of the particular actions (in terms of High, Medium, and Low) and\or what is the sequential order in the list of actions (whether this action needs to be done in 1st place, 2nd, 3rd...)
Resources	What are the resources needed (in terms of time, people and\or money) for fulfilling this action and where\how these resources are secured
Timeline	List of specific sub-actions with relative timelines
Plan to be updated?	The answer can simply be YES\NO. This column simply aims to capture any actions that should result in an update of the plan

This step will translate the actions identified in the Action table into specific measures of implementation into the plans, including identifying a timeline for the implementation of the measures and resources that are needed for the implementations. The whole table, supported by the Entity Diagram and the Cross-Table, will also provide strong and documented evidence of the reason for which the actions, and relative resources, are needed.

This can provide:

- A strong business case that will help to put the actions into practice by demonstrating the importance of securing resources
- A ‘to do’ list that can help prioritise the actions, if resources are limited, and tackle the most important issues first
- Evidence for demonstrating the importance of the identified actions to those involved in the planning process, helping to engage with them and gaining a collaborative attitude

An example of a completed table is shown in Table 2.5.

Issue	Tackling actions					Implementation			
	How to address it? Actions	**Who should bring it forward? Responsibility**	**What information is needed?**	**Is any new tool needed?**	**Who checks this is done? Audit**	Priority	Resources	Timeline	Plan to be updated?
Description of the first issue e.g. police warning households only by mobile phone – Issues related to network coverage	1. Analyse the network coverage for each area. This should be collected and stored in GIS maps for the police to analyse.	The telephone company should have this information. The police should seek and collect this information. Policeman X is the individual responsible.	Mobile telephone network coverage by area.	Information in GIS layers would be ideal. make sure this is compatible with the police system.	Policeman X is the individual responsible. Police officer Y is responsible for checking this is done and reporting back.				
	2. Decide how to use this information and how to introduce this into the emergency plan.	Policeman X to present the information to other people responsible for emergency planning. Meeting scheduled on how to use the information and to introduce it into the plan.			Relevant emergency planners ensure that a meeting is held and the actions are followed up.				

Table 2.4 Action table – Example 1

Issue	Tackling actions					Implementation			
	How to address it? Actions	**Who should bring it forward? Responsibility**	**What information is needed?**	**Is any new tool needed?**	**Who checks this is done? Audit**	**Priority**	**Resources**	**Timeline**	**Plan to be updated?**
Description of the first issue e.g. police warning households only by mobile phone – Issues related to network coverage	1. Analyse the network coverage for each area. This should be collected and stored in GIS maps for the police to analyse.	The telephone company should have this information. The police should seek and collect this information. Policeman X is the individual responsible.	Mobile telephone network coverage by area.	Information in GIS layers would be ideal. make sure this is compatible with the police system.	Policeman X is the individual responsible. Police officer Y is responsible for checking this is done and reporting back.	High – To be done first	€€€€€€ needed to be obtained From the Local Authority and central government	Police GIS facilities to be checked by Policeman X by 15 Dec 2010 Policeman X to Contact telephone company by 15 Dec 2010 to agree data sharing Seek update on data sharing by 15 Mar 2011 Set up shared database by 30 April 2011	No
	2. Decide how to use this information and how to introduce this into the emergency plan.	Policeman X to present the information to other people responsible for emergency planning. Meeting scheduled on how to use the information and to introduce it into the plan.			Relevant emergency planners ensure that a meeting is held and the actions are followed up.	High – To be done second	One day for relevant staff to attend meeting. Three days to update plan and check it	Police officer Y to set up emergency planning meeting by 15 May 2011 By 30 June 2011 policeman X to present GIS layers and their use to emergency planners Update the emergency plan by 30 July 2011 Updated plan checked by emergency planners by 15 August 2011	Yes

Table 2.5 Action table – Example 2

3 Application of the FIM FRAME method in the city of Sheffield, UK

This chapter provides an example of a practical application of the FIM FRAME method to a Multi-Agency Flood Plan (MAFP) for the city of Sheffield in the UK. The first step was to appraise the plan using the developed metrics. The appraisal is shown in Table 3.1.

The majority of the scores fell in the average or high category, with the plan overall obtaining an 'average' rating. The main weak areas were:

- Evacuation routes – no detail is provided, either on a map or in the text
- Detail is not provided on vulnerable people – there was a strong view that this information changes on a daily basis, and whilst the responders do receive updated information on a regular basis, it is not sensible to include this in the 'static' plan
- Critical infrastructure – although this is provided in a table, it is not included on a map
- NaTech hazards – in common with the majority of plans analysed to date, this information is not provided (or even known).

From this initial analysis it is clear that certain improvements could be made relatively easily, without the need for any new information or use of tools. Three possibilities are:

- Further explanation provided in the 'Scope' section on the assumptions made by the plan, such as what type of flood risks are considered
- A flowchart provided that summarises how the plan is activated and what roles the various responders take
- A diagram or flowchart is provided to show how the MAFP links in with other complementary plans, and what actions or events may require the use of each one.

With these simple changes, the average score would rise to 2.27, and the plan would then be assessed as 'above average'.

Table 3.1 Metric scores for the Sheffield MAFP

Metric	Level of detail			Score	Comments / Potential improvements
	Low	Medium	High		
Objectives, assumptions and target audience					
Aims and objectives of plan			●	3	
Target audience and updating of the plan			●	3	
Assumptions made by the plan		●		2	Provide more detail in the 'Scope' section
Organisation and responsibilities					
Actions, roles and responsibilities			●	3	
Recovery		●		2	
Training and exercises			●	3	
Plan activation		●		2	Include flow chart of activation actions
Communication					
Communication with other agencies		●		2	
Communication with the public		●		2	
Management of the media			●	3	Media management well signposted
Flood warning (if available)			●	3	Clear signposting to location of other maps
Relationship with complementary emergency plans detailed		●		2	
Evacuation					
Evacuation routes	●			1	Consider how to determine 'optimum' evacuation routes, and impact of flood on access
Shelters/Safe havens			●	3	Scored High because policy is not to include this information in MAFP
Flood hazard					
Flood hazard map		●		2	
Details of previous floods (if available)		●		2	
Flood risk to receptors					
Flood risk to people	●			1	
Flood risk to vulnerable people (e.g. elderly or disabled)	●	●		1.5	Not realistic to provide up-to-date information as it changes daily
Flood risk to residential property		●		2	Residential and business properties need splitting out

Metric	Level of detail			Score	Comments / Potential improvements
	Low	Medium	High		
					in the plan
Flood risk to businesses		●		2	"
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	●			1.5	
Potential for NaTech hazards at industrial facilities (if present)*	●			1	
	Average score			**2.14**	**An 'Average' plan**

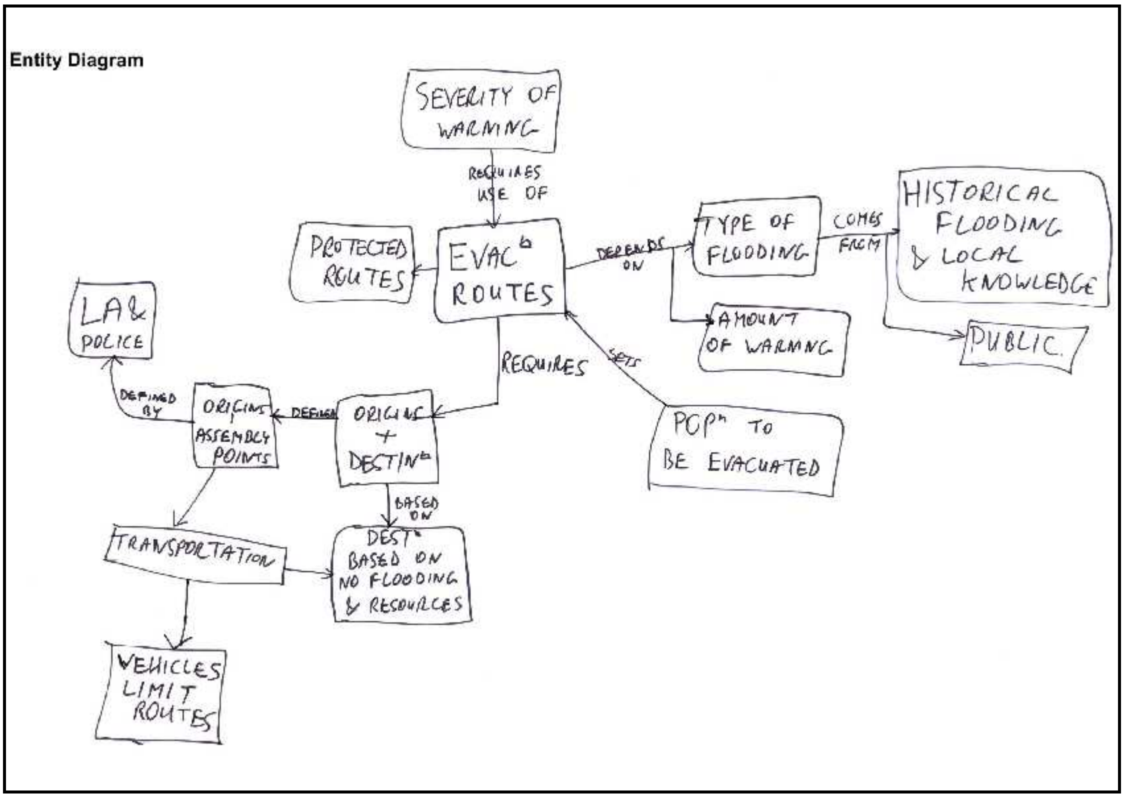
Based on this assessment, the stakeholders agreed to look at 'Evacuation routes' during the as part of the Tackle stpe. The first part of the 'Tackle' step was to build an Entity Diagram, as shown in Figure 3.1.

Part 2 of the 'Tackle' phase was to fill in the Cross Table, which breaks the entities down into:

- Processes and procedures
- Roles and responsibilities
- Information
- Tools

From the entity diagram, the various processes and procedures were identified, and inserted in the first quadrant. These were then assessed on the basis of who was responsible for them, what information was required, and whether any tools or other technology was used or needed. The resultant table is presented in Figure 3.2.

During this analysis, the participants were asked to note possible difficulties in identifying the links between the various items in the table. Lack of clarity or missing links are dealt with as 'red lights' in the tackle process. Such items are to be noted in the first column of the Action Table. From the group discussions two key issues were identified: how were the public informed of the need to evacuate, and where should they be told to go (if at all). These points are summarised in Figure 3.3.



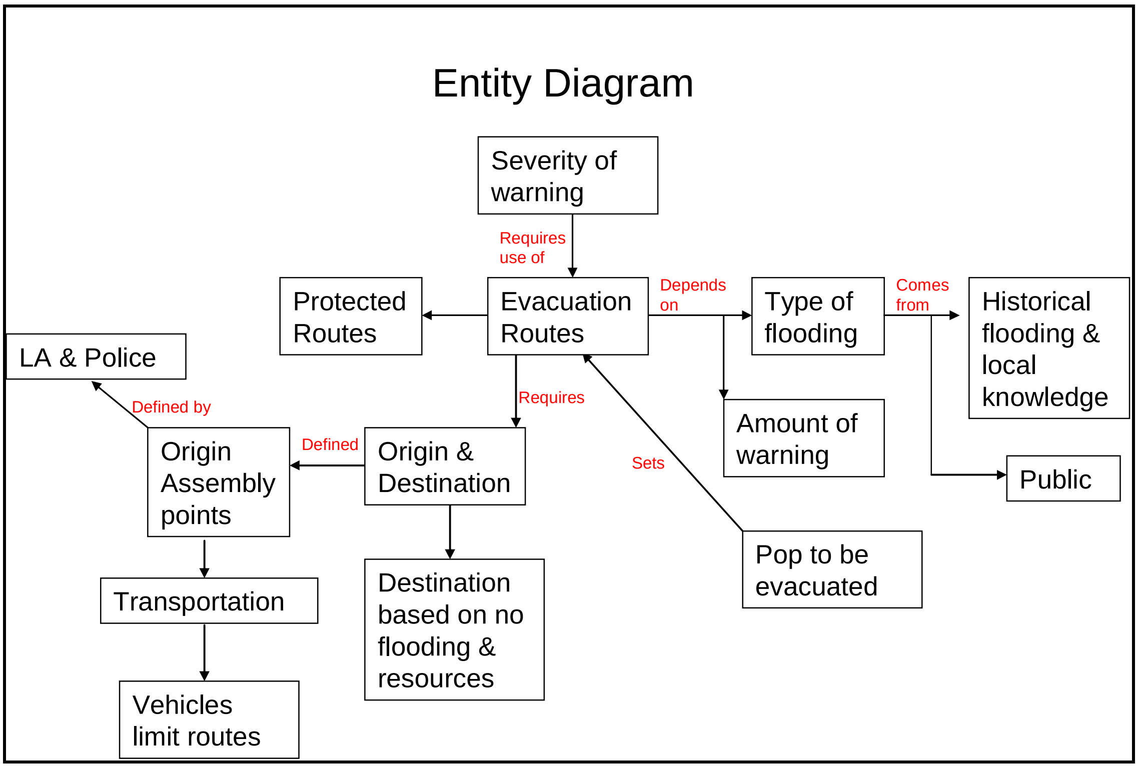


Figure 3.1 Entity diagram for 'Evacuation Routes'

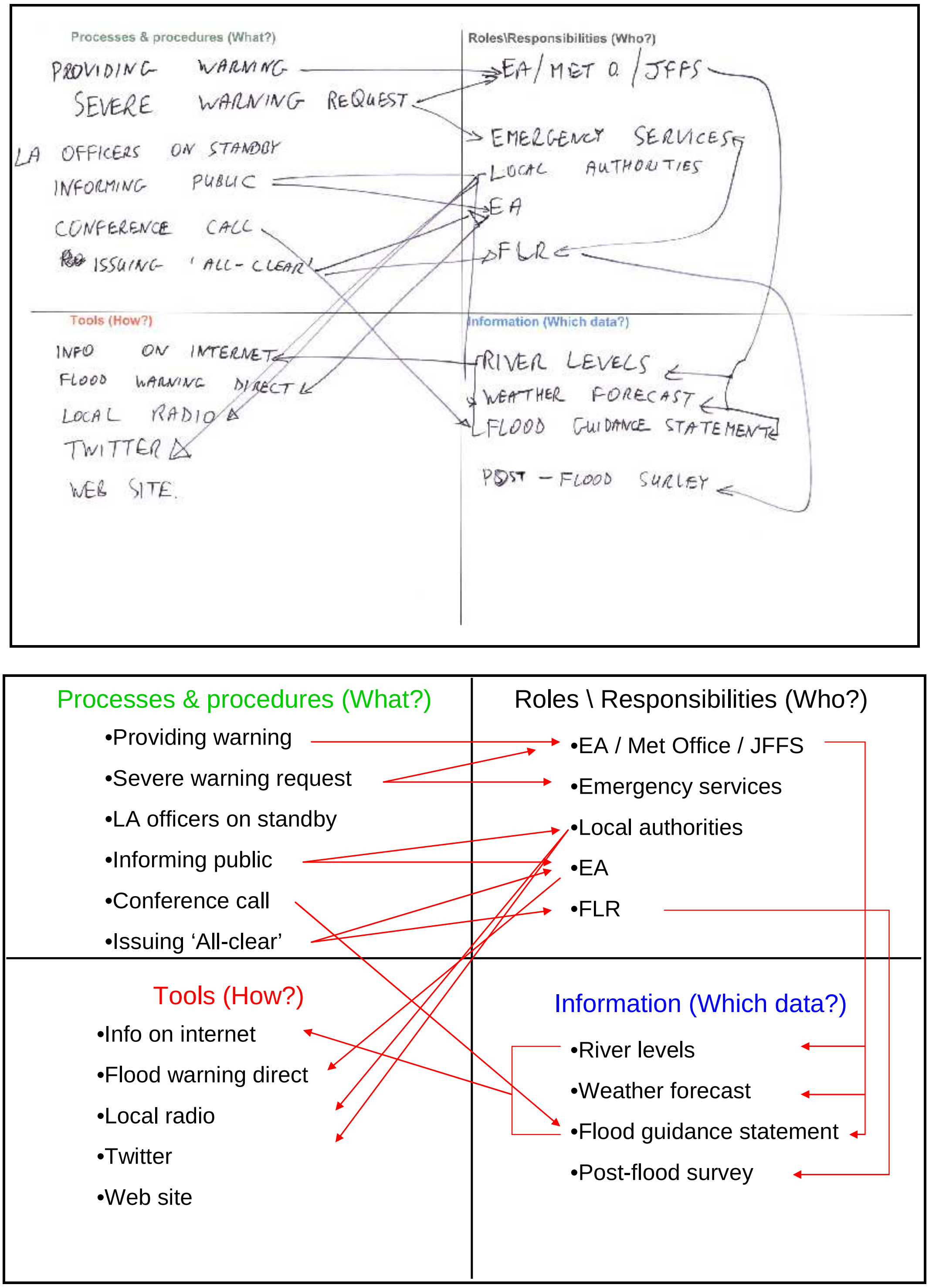


Figure 3.2 Cross Table for 'Evacuation Routes'

EVACUATION

Issues	Tackling actions				
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed?	Who checks this is done? Audit
INFORMING PUBLIC	MEDIA MESSAGE	① EA ② M.Ag.	RIVER LEVELS FLUVIAL FORECAST	RIVER MODEL LOOK TO PROVIDE TO OTHERS	TCG
	FWD	EA → M.Ag.	" REQUEST FROM M.Ag PARTNERS		EA
	DOOR - KNOCKING	LA / E.S.	" PREFERRED DESTINATIONS	GIS SYSTEM	TCG
	WEB.	M. Ag	" "		TCG
	SIGNAGE.	LA	PREFERRED ROUTES		TCG
WHERE DO THEY GO?	REST CENTRES	LA	PLUVIAL FORECAST	Y	
	GET ADDRESS DETAILS	LA/ES. POLICE.	SUITABLE LOCATIONS	GIS / LOCAL K.	TCG.
			—	CO-OPERATION	LA.

Evacuation

Issues	Tackling actions				
	How to address it? Actions	Who should bring it forward? Responsibility	What information is needed?	Is any tool needed?	Who checks this is done? Audit
Informing public	Media Message	EA M.Ag.	River levels Fluvial forecast	River model	TCG
	FWD	EA to M.Ag	Request from M.Ag partners		EA
	Door-knocking	LA / E.S.	Preferred Destinations	GIS System	TCG
	WEB	M.Ag	Preferred Destinations		TCG
	Signage	LA	Preferred Routes		TCG
Where do they go?	Rest centres	LA	Pluvial forecast	Y	
	Get address details	LA / Police	Suitable locations	GIS / Local knowledge	TCG
				Co-operation	LA

Figure 3.3 Action Table for 'evacuation routes'

Following the application of the FIM FRAME method tools were applied to assess evacuation routes and how these could affect the loss of life during an extreme flood event.

4 Use of tools in the city of Sheffield, UK

In this case of the Sheffield MAFP the impact of a dam failure on the town upstream of Sheffield was considered. Two tools were applied:

- A Life Safety Model (LSM)
- Risk to People method

The results from the application of LSM were presented at a workshop, and the animation of the flood wave and the movement of the population provided a very clear representation of where fatalities occurred and where the population needed to move to escape the floodwaters. Two key conclusions were reached:

1. The provision of an adequate warning of a breach at the dam was vital, and means to transmit this warning to the rest of the town should e considered
2. The narrow form of the valley means that fatalities only occur in the riparian zone, so if people move uphill, perpendicular to the river, this will afford the greatest safety.

The stakeholders responsible for emergency planning need to consider whether dedicated uphill escape need defining, or whether general advice can be given for people to simply move away from the river once the warning siren is heard. This also needs to consider whether specific shelter locations need to be defined. Some form of permanent signage could be used to remind people that a flood risk exists and where they should move.

Beyond this simple analysis, the LSM could be used to further investigate different warning rates and locations, plus the designation of shelters. This last option is probably not realistic as the linear nature of the town means that a large number of shelters would be needed if people were to get to high ground as quickly as possible. It is probably better to define the major roads to be used to get right away from the area, where people can be advised on where to proceed to. The results from the analysis can be used to improve the mapping of flood hazard and the location of any businesses or infrastructure that would be affected by the dam failure. To summarise the tools applied helped with the following:

- Planning evacuation routes
- Determining shelter and safe haven locations
- Defining warning arrangements

Table 4.1 overleaf provides a general overview of the tools that are available to “improve” or further develop each of the 22 metrics. It is not the aim of Table 4.1 to recommend bespoke tools as these are often country specific. However, it does provide an overview on the type of tools that are available.

Table 4.1 Overview of the tools available that can be used to meet the requirements of the metrics – Part 1

Metric	Brief description of tools
Objectives, assumptions and target audience	
Aims and objectives of plan Target audience and updating of the plan Assumptions made by the plan	Various checklists and guidelines that have been produced locally
Organisation and responsibilities	
Actions, roles and responsibilities	Tools that assist with detailed roles and the links shown diagrammatically
Recovery	Manuals and checklists detailing requirements for recovery
Training and exercises	Manuals detailing the training and exercises
Plan activation	Guidelines to assist with the definition of "trigger levels" and how these can be improved
Communication	
Communication with other agencies Communication with the public Management of the media	Checklists and guidelines to assist with communication with various key actors in the emergency management process
Flood warning (if available)	Methods to map the levels of flood warning (e.g. high, medium, low vigilance) with details of the areas flooded at each warning level and with these shown on a map
Relationship with complementary emergency plans detailed	Methods to assist with mapping of relationships between plans
Evacuation	
Evacuation routes	Suitability of evacuation routes and their accessibility can be assessed by: • Methods to access the accessibility of flooded routes for emergency services including guidance documents and simple spreadsheet analysis to assess vehicle stability • Evacuation models to assess viable evacuation routes, use of shelters and evacuation times
Shelters/Safe havens	Mapping of safe havens and shelters with their capacity and facilities on a map in relation to a variety of flood hazard scenarios
Flood hazard	
Flood hazard map	Two dimensional hydraulic models that produce water depths and water velocities. Modelling tools that can produce these results include: • FLOW-2D • InfoWorks RS • MIKE 21 • SOBEK • TuFLOW
Details of previous floods (if available)	Methods to obtain details of previous floods including: • Historical archives including libraries and newspapers • Research with local stakeholders that have experience or knowledge of historical floods • Historical flood maps showing previous events

Table 4.1 Overview of the tools available that can be used to meet the requirements of the metrics – Part 2

Metric	Brief description of tools
Flood risk to receptors	
Flood risk to people	Tools and software that can estimate the potential number of injuries and loss of life for a range of scenarios. These include methods such as: • DEFRA Risk to People method • Life Safety Model • LifeSim • TU Delft method • HAZUS method • United States Bureau of Reclamation (USBR) Procedure for estimating loss of life
Flood risk to vulnerable people (e.g. elderly or disabled)	Methods and tools that can be used: • Demographic data to map the location of elderly people and other vulnerable people • Mapping of schools, old-age peoples' homes, hospitals and nurseries
Flood risk to residential property	Methods and tools that can be used: • List the number and location of properties that are likely to be affected by a range of flood scenarios • Mapping of residential properties in relation to the flood hazard • Identification of the means by which people can be evacuated from residential properties
Flood risk to businesses	Methods and tools that can be used: • List the number, location and type of businesses that are likely to be affected by a range of flood scenarios • Mapping of businesses in relation to the flood hazard
Flood risk to critical infrastructure (e.g. water supply, gas, electricity, police, fire brigade)	Methods and tools that can be used: • Mapping of critical infrastructure in relation to the flood hazard • Methods to establish the consequences of failure (e.g. the number of people who could lose their potable water following the flooding of a water supply plant and the duration and implications of the closure)
Potential for NaTech hazards at industrial facilities (if present)*	Methods and tools that can be used: • Mapping of infrastructure and locations that could result in a NaTech hazard (e.g. industrial plants, chemical plants) in relation to the flood hazard • Methods to establish the consequences of failure (e.g. the number of people who could lose their potable water following the flooding of a water supply plant and the effect of this)

*Note: A NaTech is defined as technological hazard that is triggered by a natural hazard. For example the flooding of an industrial plant may lead to the release of a toxic chemical that poses a threat to humans, as well as flora and fauna

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